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ANATOMICAL AND POSTURAL VARIATIONS OF THE LUMBOSACRAL SPINE[1]

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IT scarcely seems possible to condense the various features of this subject briefly. My theme, however, may be stated as follows:

1. The lumbosacral area is a transitional area of the spine, *i.e.*, the fifth lumbar vertebra may partake of characteristics of a sacral segment, and, conversely, the first sacral segment may seem to rise and assume characteristics of the lumbar vertebra, in about 10 per cent of all individuals.

2. Failure of the neural arches of the fifth lumbar and first sacral segment to completely close are found in at least 20 per cent of individuals. This produces a spina bifida occulta, with X-ray shadows frequently misinterpreted as fracture.

3. A straight spine seems to be the exception. An individual lists to one side or presents an evident scoliosis. This condition is not abnormal, is purely postural, is not pathological and is not the result of trauma. X-ray shadows of a lumbar curve, with rotation of lumbar bodies, are presented upon the plates and these should not be misinterpreted as traumatic injuries. They are purely postural.

4. Hard-working individuals (male and female) such as farm hands, laborers, miners, switchmen, truckmen, warehouse laborers, all show lists or curvatures which are purely postural and the result of postures of occupation. The lumbar spine is the only dense or bony structure connecting the torso, with its hard-working arms and hands, to the pelvis and its supporting legs. This lumbar spine, therefore, is forced to sustain much stress and strain. Stress and strain crystallize into lines of force or structures bearing the brunt of strain. This crystallization into lines of force expresses itself in convexities of attitude (scoliosis), which will bear more stress than a straight spine, and in increased density of the bony margins. Therefore, the hypertrophic changes and so-called spur formations of vertebral bodies. These changes are not the answer of the bones to chronic infections. They are an answer to stress and strain—an increased strength of structure. Necessarily these changes limit motion. They may even completely fix the lumbar spine. But these changes, so often expressed as osteo-arthritis and hypertrophic arthritis, are not pathological and should not carry a nomenclature indicative of inflammation. They are purely structural changes resulting from the demands of the heavy occupation—postural changes affording greater strength to the spine.

These changes, alterations, and variations in the spinal shadows are frequently interpreted as the cause of back pain. They are misinterpreted to be the result of trauma

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or infection. They are usually seen in men and women over the age of 40 or 45. They are the records of stress and strain and are not pathological. It is not surprising to find these changes in spines of persons beyond 45 years of age, even though the occupation has not been necessarily arduous.

These reactions or responses or crystallizations of bony tissue were studied and known long before the X-ray disclosed their frequency. Sir Arbuthnot Lane described the postural changes incident to particular occupations and recorded them in anatomical drawings from autopsy specimens in 1889.

5. The sacralization of the fifth lumbar is found in fully 10 per cent of individuals. The degree varies from a butterfly type of transverse process upon one or both sides to the second degree of process, which articulates with the upper margin of the sacrum, or to the third degree of complete fusion of the large transverse process with the sacrum. The evaluation of this sacralization as a basis of clinical symptoms requires much refinement. Obviously, the fused type, being stable, offers little chance of symptomatology. Also, the first type of enlarged process produces no symptoms, except upon rare occasions of unusual length or deformed outline which engages with a moving part. There is practically no motion of the ilium upon the sacrum, except at childbirth. The lumbosacro-iliac junction is a fixed portion of the anatomy. Its function is not motion but stability. The second type, with pseudo-arthrosis between the process and the sacrum, may offer symptoms. But the interpretation of the symptoms into shadows and shadows into symptoms must be quite circumspect and entered into only after considerable thoughtful analysis.

TO RECAPITULATE

1. Sacralization of the fifth lumbar is not a pathologic or traumatic lesion—it is an anatomical variation of the normal.

2. Spina bifida occulta, or failure to close the neural arch, is not traumatic or pathologic. It is a variation in anatomical development without symptoms.

3. Postural variations of the lumbar spine should not be considered always pathologic.

4. Age changes in the spine, sometimes described as osteo-arthritis, or hypertrophic arthritis with gross spur formations, are not necessarily pathologic. They are the answer or response of the spine to the natural and occupational demands of stress and strain. They are not invariably the result of infection or the result of trauma.

5. Separate centers of ossification without fusion (uni- or bi-lateral) may occur at any transverse process of the lumbar spine, usually the first. By some, these shadows are interpreted as supernumerary ribs. They are frequently misinterpreted as fractures. It should be thoroughly understood that these transverse processes are excellently guarded and protected by distance from the external surface of the back, by cushions of muscles, and by ligaments of great mass. They are broken only by extreme, direct violence of small surfaces such as hammers, horseshoes, etc. They are rarely broken by even extraordinary muscle strains, spinal wrenching, bending, or bruising.

THE X-RAY DIAGNOSIS OF BONE TUMORS[1]

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IT has been exceedingly difficult to make this paper what I had contemplated. I am aware that the subject is not an easy one, either from the diagnostic or therapeutic standpoint. After going over the paper several times, I feel that I have not accomplished what I anticipated. It was my wish to make it comprehensive, also elementary, but, due to the scarcity of direct findings, it is very difficult to convey to the listener or reader how the diagnosis can be made from constant direct findings.

Before going any farther with the paper we must make this admission. The exact diagnosis of all bone tumors from the X-ray findings is impossible. At least this has been our experience. That the X-rays are of great value in the diagnosis of bone tumors is admitted by all those interested in the subject.

A neoplasm is a pathological newgrowth which tends to persist independently of the structure in which it lies and which performs no physiological function. The cells of a tumor may and often do functionate, as the liver cells may secrete bile in hepatic cancer. This activity, however, is not useful and does not constitute physiological activity. This is in contrast to a hypertrophy, which is due to the increased demand or to nutritive changes. The hypertrophy, unlike a tumor, tends to subside after the exciting cause has been removed.

There are two classes of tumors. The first includes those derived from or composed of connective tissue; these cells are developed from the mesoblast. This main class may be divided into benign and malignant tumors. The second main class are those derived from or composed of epithelial tissue. These tumors may be innocent or typical, composed of adult epithelium, or the atypical and malignant, composed of embryonic epithelium.

There are certain changes in benign and malignant tumors which are often quite characteristic. Malignant tumors usually infiltrate into the soft tissues as they grow. They do not push the soft tissues aside but extend into them, whereas benign tumors usually push the tissues aside and are encapsulated. These changes can often be identified on the X-ray films. The X-ray is often of value in determining the growth of a tumor and in this way the lesions may be differentiated. Benign tumors usually grow slowly, while malignant tumors grow rapidly. Benign tumors do not come to the skin and become adherent and ulcerate. Malignant tumors often become adherent and ulcerate the skin. Malignant epithelial tumors usually give rise to enlargement of the adjacent lymph glands, while sarcomata rarely do, unless the tumor be a melanosarcoma, a lymphosarcoma, or if it has its origin in the tonsil or testicle. Another important point in differentiating benign from malignant tumors is the metastasis that is prone to follow malignant tumors. Benign tumors do not as a rule cause any changes in the general health, while malignant tumors destroy the general health. While some of these points are not radiographical, they do have a definite bearing on the diagnosis. The X-rays are only an adjunct in the differentiation, but we feel we are entitled to all the available information in our efforts to arrive at a correct di-

[1]Read before the Radiological Society of North America, at the Annual Meeting, at Milwaukee, Dec. 3, 1926.

Fig. 1. Metastatic tumor, secondary to hypernephroma.

Fig. 2. Multiple enchondromata.

agnosis. It is often impossible, even when we are familiar with all the facts, to do so.

In the diagnosis of bone lesions, whether benign, malignant, or inflammatory, there are only two definite direct findings registered on the X-ray film, namely, bone-destruction and bone-production. The other findings are indirect and must be considered in conjunction with the direct findings. In trying to recognize bone tumors we must first know whether they destroy bone or produce bone. With these two facts established we must try to determine how they do it, whether they have any specific plan registered on the X-ray film, and to what extent the production or destruction is carried on.

After we have determined these facts to our satisfaction, we must look for the indirect findings which are contributory.

In discussing bone tumors we will consider them only in as far as the X-rays are of value from a diagnostic standpoint. Therapy will not be considered. In using the word "diagnosis" we mean the differentiation of benign from malignant tumors.

From the X-ray standpoint—and, we believe, from the surgeon's and patient's as well—the important point is whether the tumor is benign or malignant. If we can with certainty tell the surgeon that the tumor is either benign or malignant, we will have done all that is expected of us, and will have rendered him valuable service. We do not believe it is necessary for the roentgenologist to try to guess at the type of tumor regarding its histopathological makeup.

One of the most important factors in the accurate diagnosis of bone tumors starts with the technician. It is imperative that good films be obtained in every case. It is also essential that the member be examined in all directions at every possible angle. We have seen several grave mistakes made by not taking cognizance of these facts. There is often a definite area of invasion that can be recognized in only one view.

We are not going to try to classify bone tumors according to the types of cells. This has been attempted by our leading pathologists and after numerous meetings they

are by no means satisfied with the results of their efforts.

Primary tumors of the bones are usually sarcomatous; the only exception to this is when there is misplaced embryonic tissue. In our experience all primary malignant bone tumors have been sarcomatous.

Primary bone tumors, either benign or malignant, may occur at any age, whereas secondary bone tumors are more frequent in older persons. The most common primary carcinomata that are followed by bone metastasis are those of the thyroid, breast, prostate, and kidneys. These usually lead to one of two types of metastasis, osteoclastic or osteoblastic. The osteoclastic type of metastasis is of the destructive character. The osteoblastic is of the new-bone-producing type. There is a definite building-up process, or, probably more correctly, the deposition of lime salts. In our experience we have seen only three types of primary carcinoma followed by the osteoblastic type of metastasis, namely, carcinoma of the prostate, carcinoma of the cecum, and scirrhous carcinoma of the breast. In all these cases there was also the osteoclastic type of metastasis. The osteoblastic type of metastasis is probably an effort on the part of nature to limit the growth. It is very commonly encountered in the bones of the pelvis secondary to carcinoma of the prostate. The osteoclastic is the commoner type of metastasis. The bone is usually destroyed either in small or large areas. It is not uncommon to see a large area of the shaft of the humerus entirely destroyed. Secondary bone tumors usually occur in the shaft of the bone near the nutrient blood vessels. The metastasis may be lymphogenous or hematogenous. It is a quite common occurrence to see a secondary tumor in the proximal third of the femur following a carcinoma of the breast. This dissemination is undoubtedly hematogenous.

Secondary bone tumors are very prone to develop in the vertebræ, ribs, pelvis, humeri, and femora. Occasionally we see metastatic tumors in the bones distal to the elbow and the knee. We have seen only two cases showing metastasis in the bones of the leg. One followed carcinoma of the cecum, and one a hypernephroma. The latter case was diagnosed from the sections of the metastatic tumor by E. R. LeCount. There was no history of a primary tumor. The diagnosis was later substantiated. The X-ray films were quite typical of a secondary tumor; its origin or type, however, was not known until the sections were made.

Fig. 3. Osteoma.

The spine is very often the site of metastasis; especially is this true following carcinoma of the breast. The bodies of the vertebræ seem to be the favorite location for secondary tumors. There is one point of utmost importance in the differentiation of malignant from inflammatory lesions. In going over many films of patients suffering from carcinoma of the spine, we have never seen the articular surfaces of the vertebræ invaded. The cartilage is highly resistant to a malignant growth, whereas an inflammatory lesion usually passes through the articular surface and destroys the cartilage.

From our observations we believe this to be the most valuable roentgen finding in the diagnosis of secondary tumors.

It is not uncommon to see the bodies of the vertebræ show practically no compression, as these tumors are quite dense and will withstand considerable weight and pressure. In the far advanced cases the bodies will gradually become narrowed and some angulation will follow. The angulation is not the sharp backward angulation usually encountered in inflammatory lesions; in contrast, it is commonly in the lateral direction. These deformities are not always as described, but in reviewing many cases the lateral angulation is the common finding.

The dorsal is more frequently involved than any other part of the spine. It has been said by many writers that metastasis into the cervical spine is very rare. In our experience this has not been the case. We have observed metastasis into the cervical spine very frequently. Next to the dorsal, the cervical has been the most common location.

In advanced cases of breast carcinoma it is not uncommon to see the entire spine involved. In the early stages of the disease the areas of destruction may be rather discrete, simulating myeloma. As the disease advances, the areas become "moth-eaten" and the peripheries of the areas become indefinite and there is typical invasion.

Metastatic carcinomata are prone to involve the bones of the cranium, the lesions often being difficult to differentiate. Those that are apt to be confused with carcinoma are myeloma, lues and sarcoma. The lesions caused by carcinoma are usually multiple and are quite extensive; the edges of the tumors are not sharply outlined. The tumors extend through both tables of the bones and often invade the soft tissues. There is usually a rather typical moth-eaten appearance which is often characteristic.

Lues is often the cause of changes in the bones of the cranium. The disease is the greatest bone-producer we know of. Often accompanying the disease is the characteristic gumma. In contrast to the new-bone-production is the gumma, which is characterized by bone-destruction.

Bone-production in carcinoma of the cranium is very uncommon; in our experience it has never been observed. It is also a great rarity to see a gumma of the cranium without the accompanying bone-production. These points are of value in the differentiation of these two diseases. The Wassermann reaction is also of great value in the differential diagnosis. Primary tumors of the cranium are usually single. Though any bone may be involved, the frontal is the most common in our experience, and the occipital is the next common location. Primary tumors may cause either bone-destruction or bone-production, depending upon the type of tumor. Primary tumors, like secondary tumors, may and often do invade the soft tissues. The taking of a careful history is of great value in arriving at a diagnosis. It is often possible to get a history of a previous malignancy in carcinoma of the cranium. It is often impossible to make a definite differential diagnosis of these two diseases, from the X-ray findings alone. We believe there is, on careful study, a recognizable difference between the areas of bone-destruction in carcinoma and in sarcoma. The areas are somewhat sharper in sarcoma than in carcinoma. The lesions do not have the undermined appearance in sarcoma that is met with in carcinoma. The bones of the cranium do not show as much rarefaction in sarcoma as in carcinoma. In carcinoma all the bones of the cranium seem to show a moderate amount of reaction to the disease, such as a decalcification.

The other disease that is often hard to differentiate from carcinoma is myeloma. This disease has many of the characteristics

of carcinoma, both from the clinical and X-ray standpoints. The changes in the cranium are of great diagnostic value. These changes are often typical: the areas are circular in outline and never show new bone formation. Throughout the cranium multiple small circular areas of bone-destruction can be outlined. The lesions are very small in the early stages of the disease.

Multiple myeloma, according to Ewing, is a specific malignant tumor of the bone marrow characterized chiefly by multiple foci, a uniform and specific structure composed of plasma cells or their derivatives, rare metastasis, albumosuria, and fatal termination. The disease has been recognized for a great many years—as early as 1850 McIntyre described it under the title of "mollities ossium." At about the same time Marchand described the condition as "senile osteomalacia." In the middle of the nineteenth century the disease was described by other writers as leukemia and pseudoleukemia. McIntyre described the clinical characteristics of the disease in 1850, reporting the presence of Bence-Jones albumose in the urine and the tendency of the disease to limit itself to the bone marrow.

The name "myeloma" was applied to the disease by Rusticky in 1873. Its etiology is still obscure. The ribs and sternum are the commonest locations, while the vertebræ, skull, femora, pelvis, and humeri are frequently involved in the order named. The process is usually more extensive than carcinoma. The bones become very transparent and many irregular circular areas are seen scattered throughout the osseous system, ranging in size from 5 mm. to 3 cm. The cranium may show many tumors; Winkler reports one case in which twenty-eight tumors were observed. During the progress of the disease the bones become thin and it is not infrequent to note the occurrence of numerous fractures. As the condition advances, the periosteum is invaded and the tumor extends into the soft tissues. During the later stages of the disease the bodies of the vertebræ become flattened and the patient actually becomes shorter.

At autopsy metastasis is found to be very rare, although secondary growths have been found in the liver, kidneys, spleen, lungs, and ovaries. If the condition has been highly malignant, metastasis may have occurred in every organ of the body. Myeloma is more common in males than in females, although our series of nine cases consists of eight females and one male. The disease is most common between the ages of 24 and 69, and may continue a few months or several years. Pain is one of the first symptoms, due to the erosion of the periosteum and pressure on the adjacent tissues. Accompanying the disease is a general toxemia and the pain may become continuous or paroxysmal. The temperature usually runs subnormal during the course of the disease: occasionally, however, a high temperature may occur. Due to the fractures encountered, marked deformities are apt to occur. In our series of cases we have seen only one fracture and that was due to a very severe injury which would probably have caused a fracture in a normal bone. It was at this time the diagnosis was made. In examining the films of the shoulder the myelomata were discovered.

Blood changes are frequently noted, such as a frank anemia. A few cases have been reported in which the myelocytes had increased to 21 per cent. Bence-Jones bodies are found in less than 50 per cent of the cases of myeloma. These are occasionally found in myxedema, leukemia, and carcinoma of the bones. The albumosuria may be periodic or continuous and the amount may be large or small. The spleen may become enlarged due to the toxemia, or possibly compensatory, due to the destruction of the marrow. There is rarely any en-

Fig. 4. Giant cell sarcoma.

Fig. 5. Osteochondroma.

largement of the lymph glands. The tumors first expand the cortex of the bones, and the areas are discrete, but as the disease progresses the tumors become confluent and the cortex and periosteum become invaded. The external table of the skull may be entirely destroyed. As the tumor grows, a large mass may be felt in the soft tissues. These tumors may be rich in blood supply, and in some instances can be seen to pulsate. With the progress of the disease, the marrow disappears and the trabeculæ of the bone become absorbed. Myeloma never produces new bone. In some of the cases reported extensive areas of necrosis have developed. The termination of the disease is marked by anemia, diarrhea, dyspnea, paralysis, and coma.

Hodgkin's disease, according to Zeigler, causes many peculiar osteal and periosteal lesions formerly attributed to primary tumors of the bone or marrow or to obscure inflammatory processes. He has collected a group of these cases which he says are due to Hodgkin's granuloma. We have seen two cases of Hodgkin's disease showing changes in the vertebræ and ribs.

It has been our experience that the percentage of patients having Hodgkin's disease that show bone changes is comparatively small. The lesions, so far as we have been able to learn from our observations, are single. The two cases we have seen showed only one bone lesion each. One case had a destructive lesion in the body of the tenth dorsal vertebra: the other shows an area of bone-destruction about 2 cm. in length in the seventh rib on the right side. The area of destruction seems to involve the medullary portion of the rib, with no invasion of the cortex at the last examination.

To sum up some of the more important findings of secondary tumors of the bones—

1. Secondary tumors are usually of the

osteoclastic type showing definite bone-destruction.

2. Only very few primary tumors give rise to the osteoblastic type of metastasis. Foremost among these are carcinoma of the prostate and scirrhous carcinoma of the breast, and occasionally carcinoma of the cecum. The osteoblastic type of tumor is slow-growing and the patient usually lives longer than with the osteoclastic type. It is very infrequent to find the purely osteoblastic without some destructive changes.

3. Tumors do not invade the articular surfaces or pass through a joint. Cartilage is highly resistant to tumors. This is a very important point in the diagnosis of malignant tumors.

4. Secondary tumors occur most often near the nutrient vessels.

5. There is no normal bone within the area of invasion.

6. In the flat bones the areas of tumor are not sharply circumscribed, the edges are irregular, and there is no line of demarcation. The bone has an irregular, mottled appearance. The cortex is invaded, not merely swollen. Unlike an osteomyelitis, the tumor extends out into the soft tissues; a definite mass can usually be felt. In osteomyelitis there are areas of normal bone within the area of destruction. It is often very difficult to differentiate osteomyelitis from a primary bone tumor.

Primary bone tumors are usually of the connective tissue group derived from the mesoblast. We have not to our knowledge ever seen a primary epithelial tumor of the bone. Primary tumors of the bone may be single or multiple and may be benign or malignant. These tumors may cause bone-production or bone-destruction. The tumor may have its origin in the medulla, cortex, or periosteum. It is difficult to determine in many instances whether the tumor arises from the central or the cortical portion of the bone. As the tumor advances it is very apt to involve all of the bone.

Benign bone tumors usually attack the bone near the end of the diaphysis and are usually single. Exceptions are the chondromata and enchondromata, which are very often multiple.

Sarcomata register certain changes on the X-ray film that are often characteristic. These changes are very often difficult to identify and correlate. Only after considerable experience are we able to correlate the important findings and arrive at a diagnosis.

In examining a film it is always advisable to obtain a complete history of the case. After the history has been carefully studied try to determine the origin of the tumor, and whether it produces new bone or destroys bone. The most important factor in differentiating benign from malignant growths is the presence or absence of invasion. Benign tumors never cause invasion of the bone. There is always invasion of the bone in malignant tumors, regardless of the new bone produced. In examining a film it is well to keep in mind the fact that a giant cell tumor or a bone cyst may often seem to have invaded the cortex, but on close examination the cortex will be found to be very thin, but intact. The cortex will have been expanded but not invaded. In the presence of a fracture the cortex will be broken through, and if the fracture is comminuted the cortex may give the impression of invasion.

The commonest benign tumors are the osteomata, chondromata, and myeloid sarcomata. Osteomata are benign bone tumors cortical in origin, characterized by an abundance of new-bone-production. Osteomata may also arise from cartilage. These tumors often have a pedicle of normal bone. The top of the tumor is often irregular, like a cauliflower. The tumor may grow to a very large size: it is very common in young persons. The bone is not involved but the

tumor extends outward into the soft tissues. Osteomata show no evidence of invasion and do not tend to become malignant. They may involve any bone but are more commonly found in the frontal, mastoid, humerus, and femur.

Exostoses are often wrongly classed as tumors. They do not tend to progress without limit, therefore they are not tumors. Exostoses are very often multiple, and occur during the active growth of bone. They are usually due to an anomaly in the ossification of a temporary cartilage. Exostoses are often found in rachitic children, more frequently in boys. Multiple exostoses may be hereditary, having been traced through four generations. These growths are of normal bone and cause symptoms only by pressure and deformity. Exostoses may be of either of two types, the flat table top or the irregular cauliflower variety. They are definite bone-producers and show no invasion. The humerus, femur, tibia, fibula, cranium, and spine are the bones most commonly involved, in the order named.

Chondromata are tumors usually composed of hyaline cartilage, but they may be of fibro-cartilage, or both. They are often found in the bones of the pelvis, long bones, rib cartilage, and the bones of the hands and feet. They often spring from unossified portions of epiphyseal cartilage. Chondromata are usually encountered between the ages of 20 and 40, and may undergo changes at any time and become malignant. They are prone to develop in persons who had rickets during childhood.

The X-ray film shows a narrow pedicle which extends outward into the soft tissues, presenting a large, irregular mushroom top. Chondromata show no evidence of invasion unless the tumor has undergone malignant changes. Multiple enchondromata have the appearance of small cysts and are met with very often in the bones of the hands and feet. The metacarpals, metatarsals, and phalanges show many small cystic areas with definite capsules. There is no invasion and the joint spaces are intact. Fractures may occur through these cystic areas, which seem to heal readily.

In the medullary portion of long bones, especially the femur, a solitary cyst may develop, which is difficult to differentiate from sarcoma, clinically. Roentgenologically these cysts have a soft center with an intact periphery. The cortex is not involved in these solitary cysts or in the multiple enchondromata. There are often venous changes showing many phleboliths.

Fibroma is a rare tumor usually involving the medullary part of the bone. The tumor has a cystic appearance and the cortex is thinned but not invaded. The bones of the hands and feet are often involved; also the femur is sometimes affected. It is very difficult to differentiate fibroma from solitary cyst.

Giant cell sarcoma usually arises from bone, involving the medulla near the end. The tumor is usually single, although a few cases of multiple tumors have been reported. The cells of a giant tumor are irregular and closely locked: this is one reason why they seldom get into the blood, producing tumors elsewhere. It is very difficult to dislodge these cells from the parent tumor. Giant cell tumors grow in every direction, expanding the cortex, but, in contradistinction to a malignancy, do not destroy the cortex by invasion. The cortex often becomes very thin, and can be identified only on close examination of very clear films. The tumor is reticulated but the network is not as prominent as in a cyst. The lower end of the femur, upper end of the tibia and fibula, the distal end of the radius, and the lower jaw are the bones most frequently involved. It is possible, however, for any bone to be involved. Giant cell tumors are most common

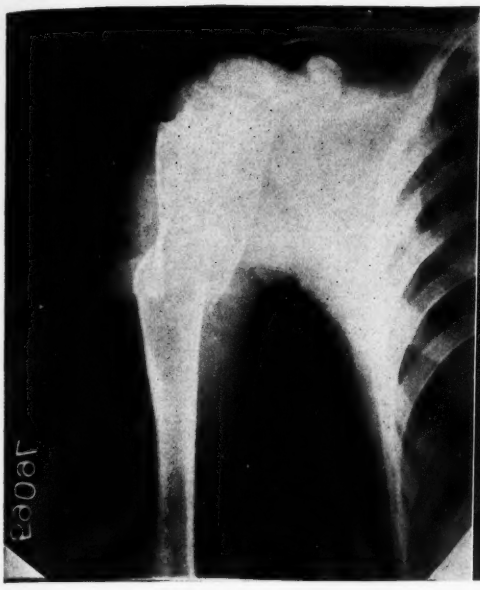

Fig. 6. Pathological fracture through a bone cyst.

Fig. 7. Osteogenous sarcoma.

under 25 years of age, and may occur suddenly, following trauma.

Bone cysts are medullary in origin, and, according to Phemister, may be due to an infection. Cysts are very common in children, although they may occur at any age. The femur, tibia, and the humerus are the bones most frequently affected. The ends of the diaphysis near the epiphyseal line are the common location of the cysts. They are limited by the epiphysis and do not extend into the epiphyseal line. Cysts are very slow growing and may not be recognized until a pathological fracture occurs. These fractures heal readily, but are apt to recur unless the cyst is cured; occasionally a fracture will lead to the cure of the cyst. Cysts grow in all directions and expand the cortex but do not invade it. The cyst is often loculated but is more often one large cyst. Cysts are sometimes confused with multiple enchondromata. The point of differentiation is the fact that cysts are single while multiple enchondromata are as the name implies.

Primary malignant bone tumors, according to Ewing, are either osteogenic or myeloid. Sarcomata may cause the destruction or the proliferation of bone. In contrast to benign connective tissue tumors there is always bone-invasion accompanying bone-production. In comparing X-ray films with microscopic reports we have been convinced that round cell sarcomata never cause bone-production. The bone is entirely swept away, probably due to the fact that the tumors are highly malignant. In spindle cell sarcoma, it is not uncommon to see some new-bone-formation, but there is also bone-invasion. We believe it is sufficient for the roentgenologist to say whether the tumor is benign or malignant and not to try to diagnose the type of predominating cell.

OSTEITIS FIBROSA CYSTICA

There seems to be a close relationship between fibrocystic disease and some of the other bone diseases such as epulis and the myeloid sarcomata. The disease may be

generalized, involving practically the entire skeleton. There are many small cysts, very common in the femur and tibia. The bones become soft and marked deformities occur. It is not uncommon to have pathological fractures occur through the areas of softening. The bone, as in osteomyelitis, may actually increase in length. If the neck of the femur is cystic, the angle may be greatly increased.

If the process involves the shaft of the femur, anterior bowing will follow, as in rickets. The cortex is expanded and irregular, but intact. Many large cystic areas are seen in the medullary cavity. The bone becomes very irregular and definite striæ of different densities can be seen throughout the bone. In some cases the cysts are very small and very hard to identify. In these cases the striæ are the dominating changes.

To summarize some of the more important findings in X-ray diagnosis of primary bone tumors—

1. Try to establish the presence or absence of bone-invasion in all tumors. If invasion can be definitely established, the tumor is malignant. If invasion cannot be established, the tumor is probably benign. If the examination has been thorough, films having been taken from all angles, and still invasion cannot be established, the tumor, we feel, is benign.

2. Infections that occur near a joint are very prone to extend into the joint and often pass through it. Cartilage offers very little resistance to infections. In a malignancy, the cartilage serves as a barrier and we do not believe a malignant tumor ever passes through a joint. This point, we feel, is of paramount importance in differentiating infections from malignancies.

3. There are certain X-ray changes in the so-called periosteal sarcomata that are quite characteristic. There are often small bone striæ extending outward, perpendicular to the shaft of the bone.

THE CONCENTRATION OF CHOLECYSTOGRAPHIC MEDIUMS AND BILIRUBIN BY THE GALL BLADDER[1]

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THE shadow obtained in cholecystography is the result of the concentration of the opaque medium by the gall bladder. Since it is excreted in the bile by the liver, it was thought that the concentration of the medium would be similar to the concentration of bile pigment by the gall bladder. It would appear that any lesion of the viscus which would interfere with the concentration of bile would also interfere with the concentration of the cholecystographic medium. Caylor and Bollman compared the bilirubin content of bile from a series of gall bladders with the anatomic changes found in these organs. They considered the amount of bilirubin as an index of the activity of the gall bladder in the concentration of the bile. Certain pathologic conditions of the gall bladder, affecting the organ as a whole, were accompanied by definite alterations in the bilirubin content of gall-bladder bile. In acute inflammatory cholecystic disease, empyema, hydrops, and contracted gall bladder, the concentrating activity of the viscus was absent. In cholecystitis associated with hypertrophic rugæ the concentration of bile was definitely increased. Between these two extremes a wide variation in the bilirubin content was found.

The difference in the character of the bile secreted by the liver and that found in the gall bladder led Kemp to suggest that the bile was concentrated in the gall bladder. Hohlweg demonstrated that, because the gall bladder was able to absorb water, it could concentrate the bile secreted in the intervals between digestion, so that the 40 c.c. of bile found in the gall bladder represented from 240 to 400 c.c. of bile from the liver. Rous and McMaster ligated the common bile duct of dogs and intubated the hepatic ducts so that the bile secreted by a portion of the liver passed into the gall bladder, while that secreted by the remainder of the liver passed into the bile duct to which a rubber balloon was attached. Control observations were made on the uniformity of the pigment content of the bile secreted from different portions of the liver. It was found that the pigment content of each cubic centimeter of bile in the gall bladder might be ten times greater than that of the bile secreted into the duct, showing that the bile in the gall bladder had been greatly concentrated. Mann and Bollman ligated the common bile duct of dogs and found that signs of icterus (bile pigment in the blood, urine, sclerotics and mucous membranes) did not develop for from thirty-six to forty-eight hours after operation. When the gall bladder was removed at the same time that the common duct was ligated, tests for bile pigment in the blood and urine were definitely positive within three hours after operation and the sclerotics and mucous membranes were definitely yellow within twenty-four hours. The difference in the rate of accumulation of bile pigment was considered evidence of the ability of the gall bladder to concentrate the bile secreted by the liver since a great increase in the concentration of the pigment in the gall-bladder bile occurred following ligation of the common bile duct. Bollman, Mann, and DePage produced specific cholecystitis in dogs by the intravenous injection of chlo-

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rinated soda. In animals in which the whole gall bladder appeared diseased, jaundice developed as rapidly as in animals in which the gall bladder was removed and the common bile duct ligated. In animals having milder disease of the gall bladder, jaundice developed less rapidly, and in animals with but slight disease jaundice developed at the same rate as after ligation of the common bile duct in normal animals. These facts clearly demonstrate that the function of the gall bladder of concentrating the bile is impaired or may be totally lost, in the presence of an acute inflammatory process in the gall bladder.

Jones found marked increases in bile pigment in the duodenal contents as obtained by Lyon's method in cases of gall-bladder disease. The abnormally high concentration of bile pigment was less marked in cases of cholelithiasis than in cases of uncomplicated cholecystitis. He attributed this to stasis of bile in the gall bladder in cholecystic disease and to hepatic changes which might be associated with this condition, although he believed that increased destruction of blood might also be a factor in some cases. However, Fitz and Aldrich examined the bile from seventy-two gall bladders removed at operation. They found that gall-bladder bile in cases of cholecystitis with stones tended to be less pigmented, of lower specific gravity, and less rich in nitrogen than the bile in cases of cholecystitis without stones, and that cloudy bile was often present in acutely inflamed gall bladders. Because of the great variation in the composition of the individual specimens of bile studied, they were unable to arrive at any but general conclusions and to correlate satisfactorily their observations with clinical and operative data.

METHOD

The pre-operative regimen for the patients in this series afforded fairly well standardized conditions with reference to the possible emptying of the gall bladder. In the chronic cases no food had been taken for fifteen hours prior to operation. In the acute cases this was also true except that in a few cases food had not been taken for a longer time.

As soon as the gall bladder was removed, it was taken to the laboratory, opened, and any unusual feature in the wall or contents was noted. Blocks of tissue were cut from the diseased areas and were immediately fixed in 10 per cent formalin. Frozen sections were made and stained with hematoxylin and eosin. A few cubic centimeters of the bile from these gall bladders was placed on ice for chemical examination. The number of milligrams of bilirubin contained in 100 c.c. of the bile was determined by the Van den Bergh method. The bile was diluted with 50 per cent alcohol until the resulting solution with the Van den Bergh reagent gave a color approximately the same as that of Van den Bergh's original standard solution. The color comparison was then made with the Dubosque colorimeter and the calculation made according to the dilutions employed.

RESULTS

Table I indicates the fifteen types of gall-bladder lesion in the 113 cases in this series, according to the gross and microscopic diagnoses. Gall-bladder diseases many times merge one into another, so that in a general way only the salient features of each disorder were described, because between some types no sharp division was possible. There were three large groups in this series: (1) the acute and subacute, (2) the chronic, and (3) the chronic inflammatory degenerative disorders. The pathologic changes found in these gall bladders were as follows:

Slight chronic cholecystitis.—Gall bladders in this group revealed the least change of any removed at operation. There were a

TABLE I

TYPES OF CHOLECYSTIC DISEASE: COMPARISON OF VARYING DEGREES OF CONCENTRATION OF BILIRUBIN IN THE GALL BLADDER WITH ROENTGENOGRAPHIC SHADOWS OF VARYING DENSITIES

Diagnosis	Bilirubin content of gall-bladder bile, mg.				Density of cholecystographic shadow			
	Cases	High	Low	Average	Dense	Normal	Faint	Absent
Chronic								
1. Slight chronic cholecystitis	8	110.0	11.0	55.3		4	2	2
2. Chronic cholecystitis	12	66.0	3.9	30.4			5	5
3. Chronic cholecystitis with papilloma	9	60.5	22.0	39.6	2		4	5
4. Chronic cholecystitis with "strawberry" gall bladder	8	71.5	8.2	28.4		3	2	3
5. Chronic cholecystitis with "strawberry" gall bladder and papilloma	1	55.0		55.0			1	
6. Chronic cholecystitis with stones	46	110.0	0.0	26.8		2*	12	32
7. Chronic cholecystitis with stones and papilloma	6	55.0	4.2	28.1			2	4
8. Chronic cholecystitis with stones and "strawberry" gall bladder	10	55.0	3.0	20.6			5	5
9. Chronic cholecystitis with stones, "strawberry" gall bladder and papilloma	1	16.5		16.5		1		
Acute and Subacute								
10. Acute cholecystitis superimposed on chronic cholecystitis with "strawberry" gall bladder	2	11.0	2.5	6.75		1		1
11. Subacute cholecystitis superimposed on chronic cholecystitis with stones	3	2.5	0.0	0.8				3
12. Subacute cholecystitis superimposed on chronic cholecystitis with stones and caramel bile	1	0.5		0.5				1
13. Empyema of the gall bladder with stones or a stone	2	0.0		0.0			2	
Chronic Degenerative and Inflammatory								
14. Chronic cholecystitis (cystic gall bladder, hydrops with stones)	3	0.0		0.0			1	2
15. Chronic cholecystitis (contracted gall bladder with stones and sand)	1	0.0		0.0				1

*One in which stones did not show in cholecystogram.

few lymphocytes in the mucosa or its stroma and the epithelium of the lining was desquamated in a few areas. The yellow pigment described by Aschoff as an apparently "normal" constituent of the cells of the gall-bladder mucosa was present in almost every specimen of this type. This pigment was concentrated in the portion of the cell near-

est the lumen of the viscus and less concentrated in the part nearest the wall. The rugæ were usually conspicuous and covered by columnar epithelium.

Chronic cholecystitis.—The gross changes usually present were thickening of the gall-bladder wall and varying degrees of infiltration of the serosa with fat. Microscopically the evidences of disease were similar to those described in the former group and in addition there was fibrosis of the wall, usually beginning as an increase of the intermuscular connective tissue. The mucosa, its stroma, and the adjacent intermuscular connective tissue were generally infiltrated with lymphocytes, plasma cells, and eosinophils. In this group there were specimens in which the connective tissue was dense and the rugæ of the mucosa had apparently decreased in height.

Chronic cholecystitis with papillomas.—Hypertrophy of the rugæ was the most striking feature of this disorder; however, apparent increase in the length of the folds of the gall-bladder mucosa was also found in other types of gall-bladder disease. Inflammatory cells were present in varying numbers in the walls of the gall bladders with papillomas. Kaufmann has suggested that the older a person grows the more papillary the epithelial lining of the gall bladder becomes. It was difficult to determine whether this change was due to age or to the inflammatory changes in the gall-bladder mucosa which many times accompany increasing years. Papillomas were grossly visible and varied in size from 1 to 3 or 4 mm. in diameter. The number present in one gall bladder might vary from one to ten or fifteen. They were composed of a stroma of fibrous tissue covered by folds of epithelium. Occasionally cholesterol was deposited in one or more papillomas. The increase in length of the rugæ apparently enlarged the surface of the gall-bladder epithelium.

Chronic cholecystitis with "strawberry" gall bladder.—Deposits of cholesterol beneath the mucosa were grossly distinguished as yellow flecks of cholesterol. The affection varied from a few small deposits usually near the cystic duct to widespread accumulations throughout the lining of the gall bladder. Microscopically the space formerly occupied by the lipoid was visible in the stroma just beneath the epithelium in fixed tissue preparations. Chronic cholecystitis with "strawberry" gall bladder may be associated with cholelithiasis, papillomas, and combinations of these disorders.

Chronic cholecystitis with stones.—One of the striking features of cholecystic disease was that a gall bladder might contain many stones and still show slight changes in the wall. The type of epithelium that was found in cholecystitis with stones varied from low rugæ, covered by low columnar or cuboidal cells, to tall folds suggestive of that already described in cholecystitis with papilloma. Desquamation of the epithelium lining the vesica was frequently associated with cholelithiasis. The texture of the connective tissue of the wall of the gall bladder containing stones was frequently changed from loose to dense. Occasionally there was edema of the intermuscular tissue and inflammatory cells were usually present in the walls.

Acute and subacute disorders of the gall bladder.—Many times acute changes in the gall bladder were apparently superimposed on previously existing chronic disease. The chronic disorder was characterized by fibrosis of the walls and infiltration with cells indicative of chronic inflammation (lymphocytes, plasma cells, and eosinophils). Hemorrhage, hyperemia of the wall, infiltration with polymorphonuclear leukocytes, endothelial leukocytes, and ulcerations of the wall were found in acute disorders.

Empyema of the gall bladder.—Stone or stones were usually present in the gall blad-

der in this disease although empyema occurs occasionally without stones. The absence of bile pigment and its replacement by purulent exudate and mucus, with signs of acute inflammation in the wall, characterize the disease.

CHRONIC DEGENERATIVE INFLAMMATORY DISORDERS OF THE GALL BLADDER

Cystic gall bladder (hydrops of the gall bladder).—Aschoff believed that hydrops of the gall bladder was an infectious inflammatory disease that developed from empyema. Cystic gall bladder was occasionally seen following occlusion of the cystic duct without stones. The epithelium in this disorder was flat and often desquamated, the walls were fibrotic and infiltrated with cells suggesting chronic inflammation. The white bile constantly found contained no bilirubin.

Chronic cholecystitis, contracted gall bladder.—This condition was probably the end-stage of chronic inflammatory changes in the gall bladder. Grossly the gall bladder was small with marked infiltration of the serosa with fat. The walls were thickened, fibrous, and trabeculated. Usually the whole structure of the wall was changed to fibrous connective tissue with areas of flat epithelial lining.

In any consideration of the pathology of the gall bladder, particularly in its relation to the concentrating activity of this organ and to cholecystography, certain fundamental morphologic changes must be analyzed. The disease changes that decrease the concentrating activity of the viscus theoretically have two points of attack: the bile before it reaches the gall bladder, and the viscus itself. Considering the former, stone or stones impacted in the cystic duct, or stricture of the cystic duct may prevent bile from entering and may interfere with the concentrating activity, as in hydrops of the gall bladder. Any acute or chronic inflammatory process which involves a sufficient surface of the gall-bladder wall may interfere with this concentrating activity, as illustrated in Table I. There may be a combination of two factors, that is, blocking of the duct and inflammatory change as in empyema.

In chronic cholecystitis with papillomas there was a lengthening of the folds of gall-bladder mucosa with an apparent increase of the surface of the epithelium of the organ. The hypertrophy of the epithelium was usually associated with great concentration of bilirubin of the gall-bladder bile. These tall rugæ were occasionally found in other types of cholecystitis. The two specimens of bile having the highest concentration of bilirubin in the series, 110 mg. for each 100 c.c., were from gall bladders which had the papillary type of epithelium, in neither case associated with papillomas; in one there was chronic cholecystitis with stones and in the other slight chronic cholecystitis. Between the two extremes of increased concentration and no concentration there was a large group of cases difficult to analyze.

The concentrating activity of the gall bladder depends on the action of the organ as a whole, so that there might be normal, impaired, and hyperfunctioning areas in the wall of the same viscus. Since the concentration of gall-bladder bile represents the sum of the activity of the organ, then fairly definite disease changes might be present in the viscus and not influence its concentrating activity. This was especially true in cases of cholecystitis with stones. As long as the stones were free in the gall bladder they apparently had little effect on concentration. The pathologic changes found in the gall bladder were frequently complicated; several gross types of disorder were present at the same time in the same organ, and exerted an influence on its concentrating action.

The shadow of the gall bladder in the

TABLE II

COMPARISON OF CONCENTRATION OF GALL-BLADDER BILE WITH DENSITY OF CHOLECYSTOGRAPHIC SHADOW

	Density of cholecystographic shadow				Total cases
	Absent	Faint	Normal	Dense	
Bilirubin content of 0 to 10 mg. for each 100 c.c. of gall-bladder bile	29	7			36
Bilirubin content of 11 mg. to 50 mg. for each 100 c.c. of gall-bladder bile	22	25	9	1	57
Bilirubin content of 55 mg. or more for each 100 c.c. of gall-bladder bile	10	7	2	1	20

cholecystogram depends on the excretion of the dye by the liver and its concentration in the gall bladder. It therefore appeared reasonable to believe that the concentration of the cholecystographic medium as indicated by the varying densities of the gall-bladder shadow would parallel the concentration of bile pigment found in the gall bladder.

The group of cases in which there was a bilirubin content of 10 mg. or less for each 100 c.c. of gall-bladder bile did not have a shadow of the gall bladder in the roentgenograms (Table II); this is as we should expect. In the intermediate group in which the bilirubin content was from 11 to 50 mg., which is about the normal variation, the response did not parallel the concentration of bilirubin. In those cases in which there was a bile pigment content of more than 50 mg. we were surprised to find that the gall bladder seldom produced a shadow. This was especially true in those cases with extremely high concentration of bilirubin. The cholecystographic drug had been administered and the roentgenograms made after dietary preparation of the patient which was essentially similar to the usual pre-operative regimen. Most of the very high concentrations of bilirubin occurred in cases with hypertrophic rugæ in the mucosa of the gall bladder, and it is quite likely that such a gall bladder concentrates bile much more rapidly than normally. One might conclude, therefore, that concentration of the cholecystographic medium did not occur in these cases because the bile was already concentrated to its maximum when the drug was administered. It is obvious that preliminary emptying of the gall bladder with a fat or egg-yolk meal should eliminate this discrepancy. We would suggest that the fat or egg-yolk be given several hours before the dye is administered, as it has been observed that when a fat meal is taken just prior to the dye the gall bladder is invisible in a much higher percentage of cholecystograms than with our usual regimen, which prohibits fats or egg-yolk at the evening meal. This is evidently because the sphincter of Oddi remains relaxed long enough to allow the dye-laden bile to flow directly into the duodenum, not entering or not remaining in the gall bladder long enough to be concentrated sufficiently to give a normal shadow.

In view of the results of this study it would appear that, while cholecystography is a reliable test of the function of the gall bladder, dependence on it as a diagnostic

measure should not be encouraged to the exclusion of older clinical methods. Graham's contribution of cholecystography not only takes high rank among the advances that have been made in the diagnosis of cholecystic disease, but also offers a convenient method of studying the physiology and clinical pathology of the gall bladder, concerning which much remains to be learned.

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THE ROENTGEN DIAGNOSIS OF MALIGNANT NEOPLASMS OF THE LUNG[1]

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THE difficulties which clinical diagnosis of lung tumors presents were clearly appreciated by the older clinicians who fostered also the tradition that only in the rarest instances were newgrowths primary in the lung. With the advent, however, of more precise and accurate methods of diagnosis, but mainly as a result of disclosures of the X-ray examination, the diagnosis of this disease has been clarified and simplified and the fallacy of the conclusion regarding its rarity has been convincingly demonstrated.

As a consequence of this there has been a renewed interest in the diagnostic problem which the disease presents, a closer scrutiny of its clinical aspects and more careful pathological investigation, with the result that numerous observers all over the world are now reporting cases of primary pulmonary carcinoma. The 374 cases cited by Adler in 1912 have been amplified more than tenfold since that time.[2]

This state of affairs has, however, led some to the conclusion that the disease has actually increased in its frequency in the last fourteen years. Many causes, all based on the theory of local irritation, have been ascribed as responsible for this increase. These include cigarette smoking, the dust of foreign particles in the air incidental to modern labor and traffic, the dust of tarred roads, the dust and gases from imperfect fuel combustion from automobiles and modern industrial processes,[3] and the productive pulmonary changes following influenzal broncho-pneumonia.[4]

None of the etiological factors given are entirely acceptable and all have had numerous objections cited against them. It is evident that the final decision as to the cause of primary pulmonary carcinoma will have to await the determination of the factors governing the cause and localization of carcinoma in general. Even though it were true that the increase in the incidence of pulmonary carcinoma has been more apparent than real, the fact remains that the more accurate diagnosis, both on the part of the pathologist and the clinician, assisted by the roentgenologist, is greatly responsible for the more frequent recognition of this disease.

GROSS PATHOLOGY

That the varying roentgen appearances may be appreciated it is necessary to have a clear concept of the varying morphological

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[1] Read before the Twelfth Annual Meeting of the Radiological Society of North America, at Milwaukee, Dec. 3, 1926.

[2] According to some statistics, lung carcinoma has one-third the frequency of stomach carcinoma and has come to hold second place in the statistical list of the frequency of visceral carcinoma (Kikuth, Hamburg necropsy records). More accurately, however, pulmonary carcinoma holds the seventh place in the order of frequency of carcinoma. The disease has an incidence of 0.15 per cent of all autopsies, about 1 per cent of all carcinomas, and 2 per cent of all deaths from pulmonary disease (Grove and Kramer).

[3] In regions where soft coal is extensively used, the inhalation of smoke carbon and other chimney products cannot be prevented. Because of the minute size of the particles their diffusion is governed by the laws of molecular diffusion; that is, they diffuse themselves independently of air currents as well as by means of air currents. Their effect is chemical as well as physical. Smoke carbon particles are tarry in character. Because of their chemical affinity for moisture they become nuclei, on which moisture gathers. In such cases they are apt to become chemically active. The sulphur vapors also gather moisture, forming sulphurous and sulphuric acids, both of which are irritating to the mucous membranes. It is doubtful if any practical means of eliminating these sources of irritation exists.

[4] It might, however, be said in reference to the local irritation theory that it does not necessarily follow that the irritation must arise from external factors alone. It is to be pointed out that the lung serves as one of the main eliminatory organs of the body. It is possible that some irritative agents circulating in the blood may be secreted at the pulmonary epithelium and produce its irritation this way. According to Yandell Henderson (*Brit. Med. Jour.*, Jan. 9, 1926), not only is absorption from the lungs more rapid than from the stomach, the subcutaneous tissues and even from intravenous infusion, but as regards elimination of any substance, the lungs are incomparably the most rapid channel.

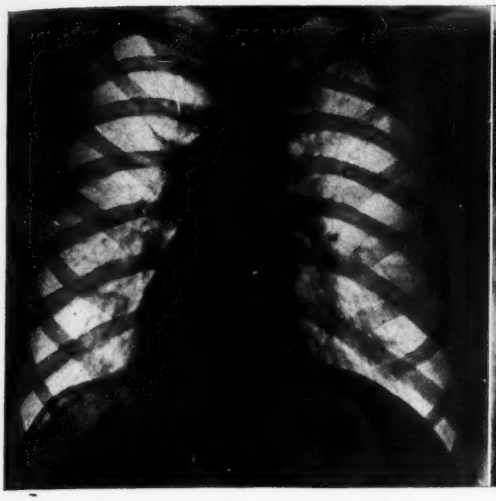


Fig. 1. Early stage of bronchial carcinoma, apparent merely as an enlargement and distortion of the left hilum shadow, most marked in the upper lobe branch.

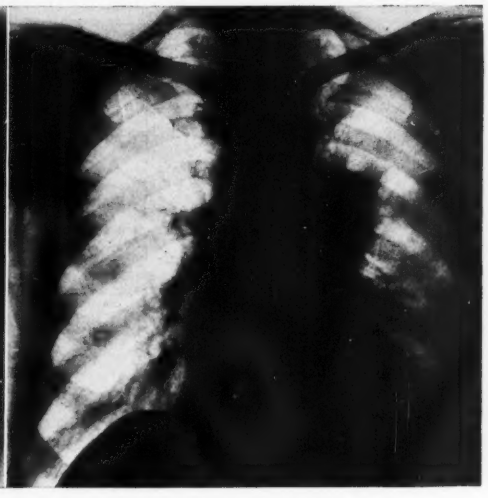


Fig. 2. Slightly more advanced stage of bronchial carcinoma. The distortion and enlargement of the hilum shadow is more marked. The pulmonic markings radiating from the shadow are increased in size and number, their confluence producing an irregularly triangular shadow, its apex in the pulmonic field and its base at the median shadow. A small amount of fluid is present in the left costophrenic space.

changes in terms of gross pathology. These depend on—

(*A*) The type of the tumor;
(*B*) Mechanical consequences of the growth of the tumor;
(*C*) Reactive processes in the surrounding lung and pleura;
(*D*) Secondary circulatory and degenerative processes in the tumor tissue.

(A) Type of Tumor

The pathologists usually describe three forms of pulmonary growth: (1) nodular; (2) infiltrating; (3) miliary.

Besides these, there is a pleural form shown as a dense nodular infiltration of the pleura and adjacent lung.

The morphology of the tumor may be studied under the following heads: (*a*) shape; (*b*) position; (*c*) relation to the bronchus; (*d*) size; (*e*) manner of extension; (*f*) number.

(*a*) *Shape.*—(1) The *nodular tumors* are either single or multiple, more or less spherical, and sharply circumscribed. This form more or less maintains its original shape, no matter how extensive the growth or how numerous the foci. They are usually solid in consistency.

(2) The *infiltrating form* invades the lung as a process without definite shape; but since its origin is in the main bronchial branches, the process extends outward from the root into any part of the lung in a more or less triangular mass, the base being formed by tumor and involved mediastinal structures and the apex by involved and atelectatic lung. In the later stages the irregularly shaped tumors may take on the form of the lobe or lobule in which they are located and may be sharply delimited by the interlobar fissures.

(3) The *miliary type* consists of small miliary foci situated along the lymphatic vessels.

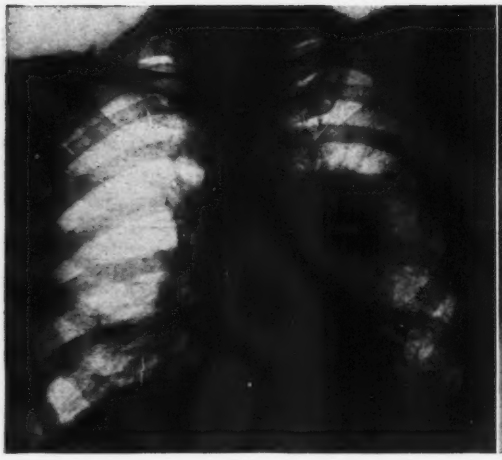


Fig. 3. Bronchial carcinoma of the left lung. Here as yet the localized area due to involvement is circumferentially disposed about the hilum of the left lung. There is an interference with the aëration of the left lower lobe.

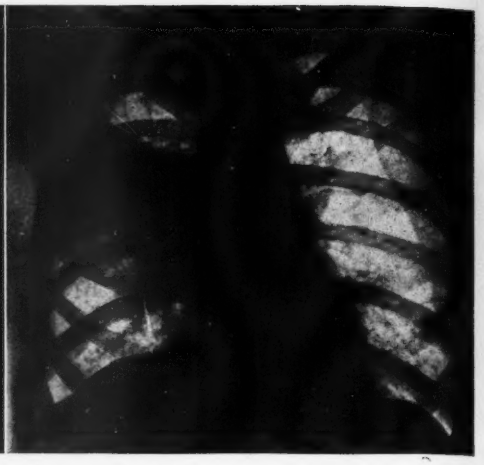


Fig. 4. Bronchial carcinoma at the root of the right lung, extending out from the right hilum shadow into the pulmonic field as an oval shadow with irregular, frayed-out contours. A small effusion is present between the upper and lower lobes, and the middle lobe is partially atelectatic.

(*b*) *Position.*—From the standpoint of location the masses may be grouped as (1) hilar, (2) parenchymal, (3) pleural. The hilar correspond to the bronchial type (arising either from the mucous glands or bronchial epithelium); the parenchymal correspond to the alveolar type, arising from the finer bronchioles or alveolar epithelium, and the pleural correspond to an endothelial type of tumor, which covers the lung as a thick nodular sheath.

The rounded or nodular type of tumor may be located in any portion of the lung, most commonly, however, in the upper part. The hilar tumors most commonly spring from the upper lobe main bronchi, though any branch may be involved. In the miliary type of disease the foci are diffusely scattered to all parts of the lung.

(*c*) *Relationship to Bronchus.*—The tumor may grow (1) along the bronchial wall eccentrically without affecting the lumen, converting the bronchus into a thick-walled tube, (2) as an annular growth gradually diminishing the lumen, (3) as a ball-like mass completely obturating the bronchus. In the late stages, the peribronchial tumor masses encircling the bronchi may compress them from without, producing partial or total occlusion.

(*d*) *Size.*—The tumor may vary from the size of the head of a pin (miliary type) to a mass occupying the entire lung. The largest single circumscribed masses are produced by sarcoma. The large number and small size of the foci is a characteristic of the miliary type. The nodular parenchymal cancers increase in size concentrically, the infiltrative hilar tumors grow irregularly.

(*e*) *Manner of Extension.*—From the primary deposits there may be—

1. Extensions to other portions of the pulmonary parenchyma or pleura in the form of smaller or larger nodules in the same or opposite lung, apparently isolated or in the form of irregular masses connected with the primary focus.

2. Extensions from the primary growth along the peribronchial and perivascular lymphatics.

(*f*) *Number.*—The primary tumor mass itself is usually single and isolated, with the

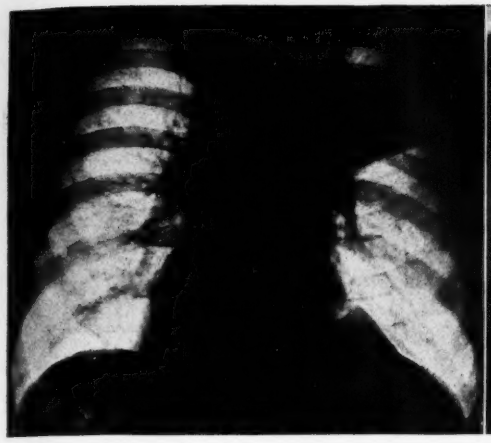


Fig. 5. Small bronchial carcinoma, involving the bronchus of the right upper lobe and producing partial atelectasis which later became complete. A vertebral costophrenic effusion is present on the same side.

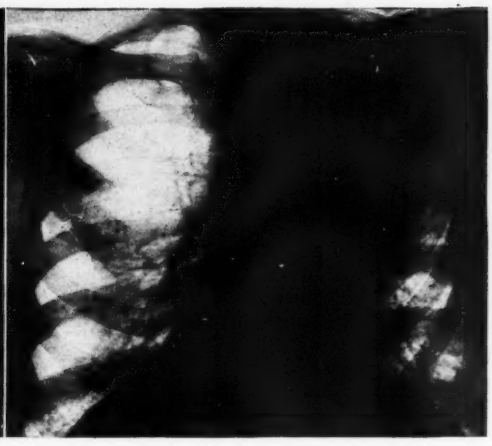


Fig. 6. Bronchial carcinoma of the left upper lobe, with complete infiltration and atelectasis of the left upper lobe. In this case the abscess resulting from breaking down and infection of the tumor perforated the chest wall.

exception of the diffuse miliary type. Frequently in the path of an infiltrating tumor, small localized nodules may be seen as advancing areas of involvement. The primary tumor may be small but the metastases from it may be numerous and large. A primary nodule in the bronchus may be responsible for a large pleural mass.

(B) Mechanical Consequence of Compression

The most striking and important of the consequences of mechanical pressure upon the bronchi is atelectasis.

If bronchostenosis is complete, there is atelectasis of the corresponding part of the lung, the air remaining in the alveoli is quickly absorbed by the circulating blood, and the lung shrinks. If the occlusion is incomplete, the bronchi distal to the point of obstruction become dilated. There then follow fibrosis and infection, with the reactive processes indicated below.

In the early stages of the tumor, the heart may be displaced away from the affected side, but as the lobe collapses the reverse occurs. The heart and mediastinal contents are deviated to the side of the lesion. The diaphragm is elevated.

Either directly because of the growth or as an indirect result of the retraction there may be pressure on the adjacent structures, the superior vena cava, the inferior vena cava, the aorta or its branches, the pulmonary artery, the heart and pericardium, the trachea, esophagus, vagus, sternum, spine, and ribs.

(C) Reactive Processes

Usually there are considerable areas of (1) lobular pneumonia surrounding the neoplasm; (2) interstitial inflammation with extensive bronchiectasis; (3) thick plastic exudates forming firm adhesions, with calcareous deposits; (4) serous, serosanguineous, or purulent pleural effusions.

(D) Secondary Circulatory and Degenerative Processes

The nodular types of tumor, whether primary or metastatic, may, as a result of its rapid growth and insufficient vascularization, undergo necrosis, with cavity for-

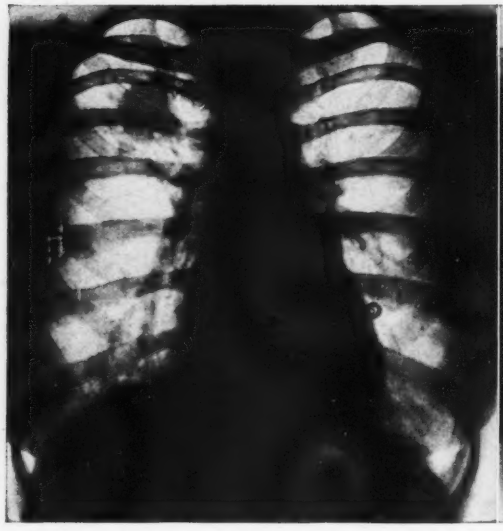


Fig. 7. Small alveolar carcinoma involving the apical portion of the left lung. The tumor mass is circular in outline and sharply circumscribed. It has no apparent connection with the hilum structures. In its early stages it had been mistaken for an apical tuberculous deposit.

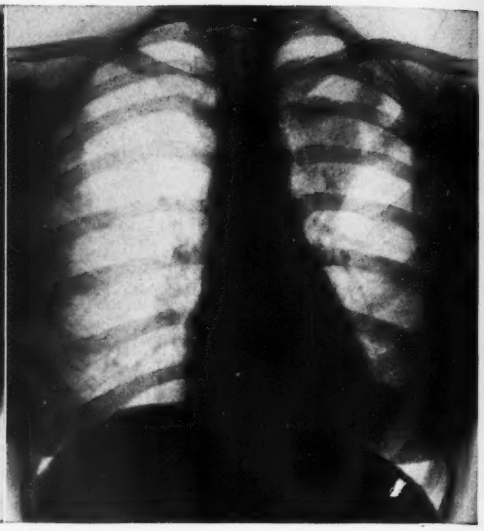


Fig. 8. Alveolar carcinoma of the left upper lobe. The tumor mass is roughly oval in shape, sharply circumscribed, definitely outlined, and located in the posterior and median portion of the lobe.

mation, which, secondarily infected, becomes filled with pus.

The cavities may be small and discrete and numerous, or single and very large, with but a thin shell of friable tumor tissue enclosing the pus. Hemorrhages into a cavity of tumor are common. The abscess formation may perforate the chest wall. Sarcomatous nodules are less liable to this degenerative process than carcinomatous deposits.

Summary

Though a case of lung tumor may present, when first seen, but a single one of the pathological changes discussed, the average, particularly the case of long standing, presents in a greater or lesser degree nearly every variety of direct or indirect change of tumor formation. These may be enumerated as follows:

A tumor mass with irregular contours in the vicinity of the hilum, infiltrating the parenchyma and extending usually into the upper lobe, and bearing a definite relation to a more or less patent bronchus from which the tumor originated. This is the most common form. In its later stages it appears as a diffuse, irregular, not sharply delimited infiltration of one or more lobes, resembling an extensive consolidation.

A nodular mass or masses of varying size with well defined outlines embedded in the parenchyma, bearing no definite relationship to the bronchus.

Diffusely scattered coarse and fine miliary foci.

A thick, dense, hard, nodular envelopment of the pleura and adjacent lung.

Atelectasis, abscess formations, interstitial inflammation with bronchiectasis, lobular consolidation, pleural adhesions, pleural effusion, massive mediastinal lymph node enlargement.

DIAGNOSIS

The clinician may take umbrage at a roentgenologist having the effrontery to criticize

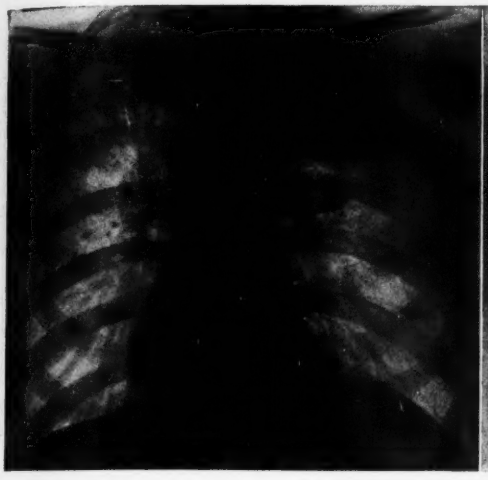


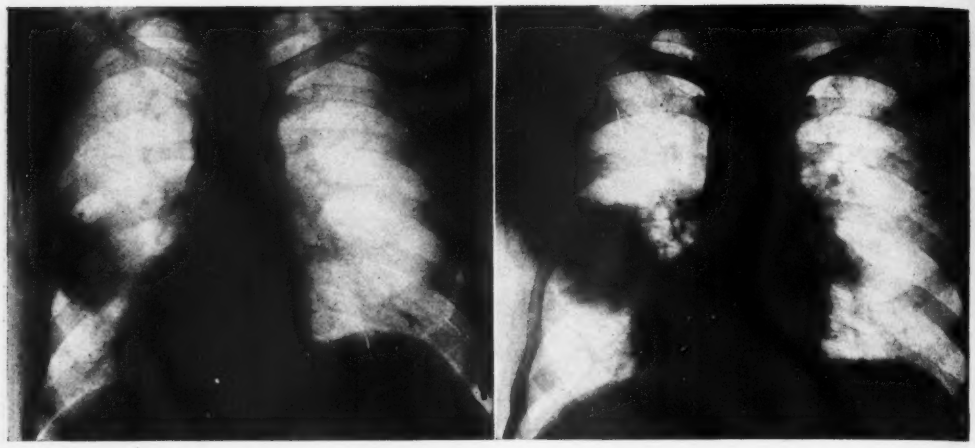
Fig. 9. Alveolar carcinoma in the right upper lobe associated with a tuberculosis in the left upper lobe. The tumor is round in shape, sharply circumscribed, definitely outlined, and almost completely fills the right apex.

Fig. 10. Complete atelectasis due to involvement of the right upper lobe by the lung tumor mass, with involvement of the hilum structures. There is marked elevation of the right diaphragm. There is a small effusion in the right costophrenic space.

clinical methods, but the roentgenologist is entitled to a viewpoint of his own regarding the comparative value of the contribution which roentgenology makes to clinical diagnosis. Roentgenology loses more, clinical medicine gains less, from clinicians who think themselves roentgenologists than from the roentgenologists who think themselves clinicians. There has always been a marked tendency on the part of certain internists to disparage the value of the roentgen examination in favor of other methods of diagnosis, particularly as regards the results attained by physical diagnosis, percussion, auscultation, etc.

Of course this attitude is not new to those who have been active in the establishment of the value of the roentgen examination in diagnosis. They have come in contact with this state of mind before—in those days when the roentgen examination was opening up the sealed book of gastro-intestinal diagnosis. At that time, too, the X-ray examination had to fight against this same influence. It was stated again and again that X-ray examination was not essential to diagnosis—test meals, palpation, strings, buckets and other clinical methods were more accurate and conclusive. Who dares to assume this attitude to-day?

Just now the battle is being fought in the field of chest diagnosis. Step by step the percussionist is giving ground. As far as the value of physical signs in tuberculosis are concerned, it is only now, after a long controversy, that clinicians begin to concede that the X-ray examinations give more striking evidence of even the earlier lesions of the disease than do physical signs. Thus, Monroe and Emery (*Boston Medical and Surgical Journal,* April 8, 1926) studied a series of patients to determine the best criteria to serve as an indication for the X-ray examinations of the chest, in cases in which the physical findings or symptoms suggested pulmonary tuberculosis. Their conclusions are that the X-ray examination should always be made when the presence of tuberculosis is suspected and that the physical findings are less reliable guides and of less diagnostic value than the results of the roentgen examination. Nevertheless, the majority

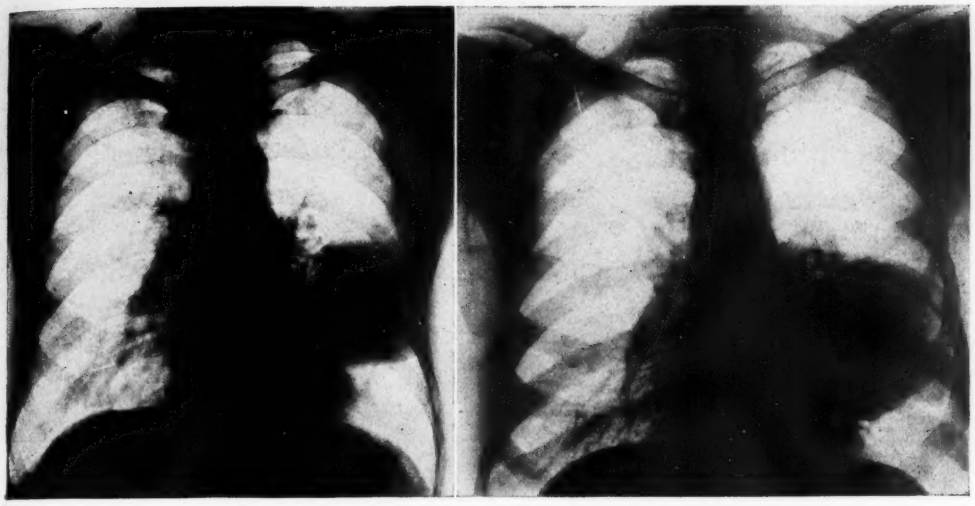


Figs. 11 and 12. Illustrating the advancing concentric growth of an alveolar carcinoma in the upper portion of the left lower lobe.

will still maintain that it is only by physical signs, the dulling of the percussion note, the râle and the variation in the broncho-vesicular breathing that the actual conditions within the lung can be determined with accuracy. These meager, inconclusive, vague, and indefinite signs are the material out of which they try to write the whole true story of the variety and distribution of a particular tuberculous lesion in the lung. Yet in 98 cases out of 100 the X-ray examination gives a clearer and more accurate idea of the lung pathology than the most painstaking physical examination, and a series of radiographs taken at intervals gives a better idea of the activity of the lesion and its various pathological phases than do any number of physical examinations. So that when Bruns states (*Jour. Am. Med. Assn.*, Sept. 5, 1925, LXXXV, 739): "Of all methods at our disposal the roentgen ray is the most important factor in placing before us the pathological condition of the lungs in pulmonary tuberculosis," he gives the verdict of the enlightened and progressive clinician.

Of late, for reasons previously given, the question of malignant tumors has been of particular interest, and the value of the roentgen examination is being commented upon and weighed mostly by internists who are not roentgenologists and have not the roentgenological experience qualifying them to give the necessary value to the data disclosed by the roentgen examination. They consider the X-ray as being of but little value and of little importance in the diagnosis and lay emphasis on the physical findings and symptomatology. All this in spite of the fact that their invariable conclusion is that there are no pathognomonic symptoms of tumor of the lung, and that, though weakness, cough, expectoration, pain in the chest, and dyspnea are significant phenomena, they usually are late in appearance.

As for the physical signs, these are frequently given as "negative" or "showing nothing noteworthy," "dullness and râles," "signs of consolidation," "signs of effusion" (flatness, diminished tactile fremitus, distant tubular breathing, bronchophony, pectoriloquy). With every heading given—taken from reported clinical records—there may be found tumors of the lung, single or multiple, hilar, parenchymal, pleural involvement, necrosis of tumor masses, atelectasis—namely, nearly every variety of lesion or complication of pulmonary tumor. There is



Figs. 13 and 14. A continuation of the series shown in Figures 11 and 12.

thus nothing sufficiently distinctive in the physical signs to indicate the particular nature of the lesion.

It is stated that flatness over a limited area, combined with feeble or absent breath sounds, when found in a person of cancer age, giving a history of an insidious appearance, of cough, dyspnea, hemoptysis, and pain in the chest, suggest tumor. But with such a history the X-ray does more than suggest; it permits the making or exclusion of the diagnosis of tumor of the lung with as much certainty as a diagnosis can be made.

Fishberg (Diagnosis of Pulmonary Neoplasms, *Archiv. Int. Med.*, June, 1926, XXXVII, 745-772) states that in his experience physical exploration of the chest is more likely to indicate the location of the growth at an early stage than the roentgen ray and that he has repeatedly localized tumors of the lung by percussion and auscultation when the roentgen findings *were entirely negative or inconclusive* (the emphasis is ours). This is typical of the opinion of some clinicians as given in the literature. The question arises, Is there any basis for such statements? Does the X-ray fail to record or is the lesion recorded and does the fault lie in technic and interpretation? If so, is it the faulty technic and interpretation of the roentgenologist or of the clinician which is responsible for this state of affairs?

It is a very rare experience to find a tumor at postmortem whose shadow can not be demonstrated on the film. On the other hand, it is a very common experience to demonstrate pulmonary neoplasms which give no physical signs whatever, and which even after their locations have been demonstrated in the film fail to disclose any physical signs. True, there are limitations to the X-ray examination in the sense that it may not always be possible to isolate the components of a certain density, as that due to a combination of a pleural effusion and a tumor, or to the reactive changes in the parenchyma and its cause—a bronchial newgrowth.

An effusion hiding the lung may permit no conclusion from the roentgen examination as to the actual lesion behind the fluid, but do a flat note, the absence of breath and voice sounds at the base, permit any differentiation between tumor, thickened

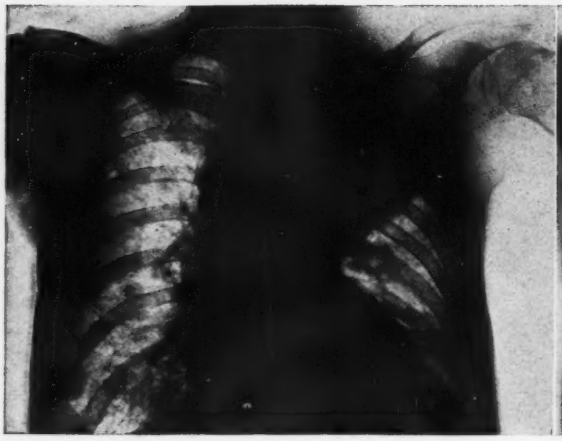


Fig. 15. Perforation of the chest wall, by a bronchial carcinoma in the left upper lobe, with involvement of the soft structures.

Fig. 16. Perforation of the chest wall, with destruction of the ribs and involvement of the soft structures, by a very large alveolar carcinoma of the right upper lobe.

pleura, or pleural effusion? Not even after a consideration of the history is the clinician always able to arrive at any positive conclusion regarding the significance of the above physical signs. Some complex combinations of lesions cannot be cleared up by any method short of autopsy. But when one considers the numerous obvious limitations of physical diagnosis, the superiority of the roentgenogram is strikingly apparent to any except the prejudiced mind, filled by old and outworn ideas and traditions, refusing to accept what is different and new.

There are several articles in the recent literature giving a clinical and pathological study of pulmonary carcinoma of the lung. An unbiased analysis of these reports does not show the superiority of the physical over the X-ray examination in disclosing the actual conditions.

I know it is heretical even to dare breathe a criticism of the ancient and honorable methods of percussion given to the world by Auenbrugger, or of the time-worn method of auscultation of the great clinician, Laënnec, the hundredth anniversary of whose death is this year [1926] remembered. The stethoscope is 110 years old, a revered instrument which has served its purpose nobly. But we are living in an age which demands precision and quantitative measurement. The variations in the percussion note or the audition sounds never have been registered in the diatonic or chromatic scales.[5] The roentgen image is an impression recorded by physical agencies according to physical laws, indelible, definite, measurable and precise. True, the problem of its interpretation is by no means entirely solved—but auscultation is 110 years old and it is but a short time since the roentgen method was first applied to chest diagnosis.

The shortcomings of the X-ray examination lie in the failure of interpretation of the record obtained. One appreciates what

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5The quality of the sounds, as interpreted by the ear, depends on two factors: the relative intensities of the various frequency components that make up the whole, and the relative sensitivity of the ear at these frequencies. The quality of the sounds is described by adjectives, which either imitate them in spoken syllables or convey the idea of relative intensity and pitch, as: breezy, rough, high pitched and low pitched; and for rales, crackling, coarse, fine, moist, and musical.

The terms are purely relative and there is no uniformity in phraseology. The sounds are complex and very few of them appear as simple musical tones characterized by a definite musical pitch. Most are made up of a mixture of frequency components of various intensities within certain regions of the frequency scale.

Even by the use of the electric stethoscope no difference in the frequency characteristic exists between the various rales, and the frequency characteristics, for instance, of amphoric and bronchial breathing are about the same.

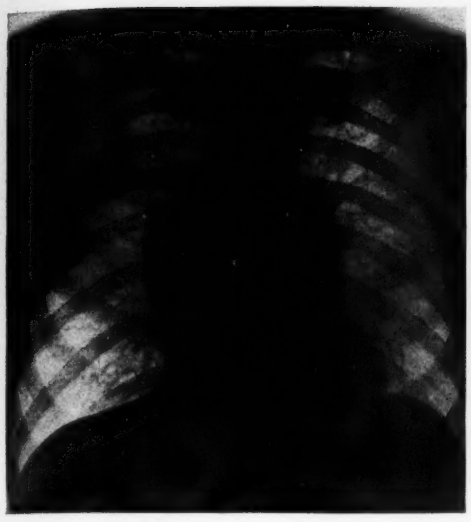

Fig. 17. Bronchial carcinoma of the root of the right lung. When first observed the tumor appeared merely as a slight distortion in form of the upper portion of the right cardiac shadow with so little deformity that it had been mistaken for a pleuropericardial adhesion. The tumor growth in this case was apparently at first localized but rapid perforation at its point of origin produced diffuse involvement of the hilus structures.

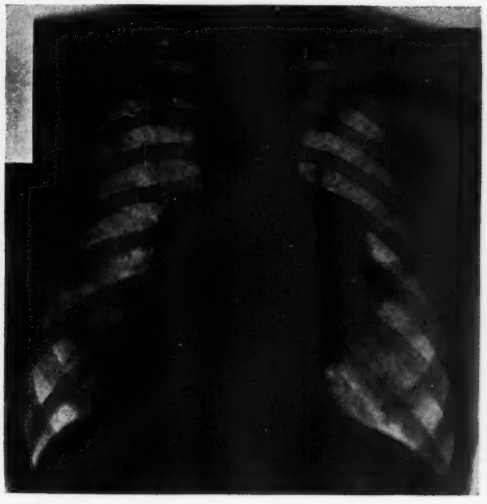

Fig 18. Second film, six months later, showing progression of case shown in Figure 17.

Montaigne meant when he said, "There is more ado to interpret interpretations than to interpret things themselves," when reports of cases of lung tumor are given as follows: "Left apex clouded; right upper lobe showed dense clouding. Trachea not displaced. Mottling was not proportionate for the extent of the shadow, suggesting that it may not be tuberculous." The case was one in which a tumor 7 cm. in diameter existed in the left apex, associated with other tumor nodules.

Such reports are neither credits to roentgenological accomplishment nor aids to the confused clinician groping in the indecisive conclusion based on chest thumping and sibilations. It must be admitted that the interpretation of the X-ray examination in many of the cases analyzed in the literature is, to say the least, not brilliant. Often the conclusions, if such X-ray reports are to be flattered by being called conclusions, are confusing and useless.

When, however, the roentgen film is interpreted intelligently and a definite opinion given, then the examination becomes a very valuable aid in the diagnosis. Thus Lichty, Wright, and Baumgartner, in an article on lung cancer (*Jour. Am. Med. Assn.*, July 17, 1926), state that they consider the roentgen-ray examination to be invaluable. In the cases studied, the opinion given was usually definite as to the possibility of a newgrowth and they therefore feel that the opinion of a *competent* radiographer should carry much weight. They state that it is doubtful if they would diagnose cancer of the lung should the roentgen report be to the contrary. In many of the articles in the literature, much emphasis is laid on the value of the bronchoscope in this field of diagnosis. There is no antagonism between the bronchoscopic and the roentgen examinations. On the ground of simplicity, practicability, and routine, it is far simpler and easier to make the roentgen examination than the bronchoscopic. When the diagnosis is in

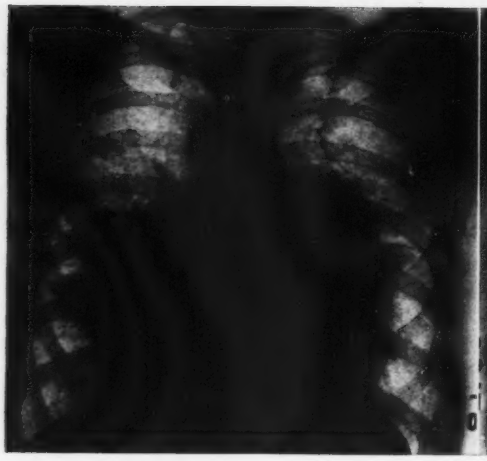

Fig. 19. Diffuse bronchial carcinoma. Complete involvement of both lungs. This lesion probably had its origin in a localized bronchial carcinoma which rapidly perforated the bronchial wall and invaded the lung tissues. There is a diffuse miliary metastasis and direct lymphatic extension to the opposite side.

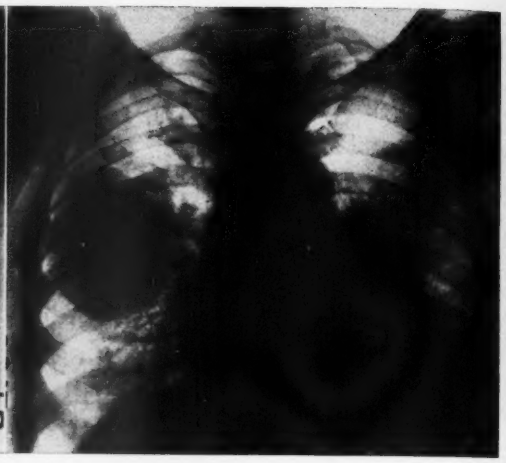

Fig. 20. Bronchial carcinoma at the root of the left lung, with atelectasis and pleural effusion. In the lower lobe of the right lung there is a large circumscribed metastatic mass.

doubt, when it is desirable to have confirmatory evidence, when the exact cellular nature of the tumor is sought, then the bronchoscopic study has its greatest value. It is true that there must be a stage when the lesion is so small as not yet to occlude the bronchus or to markedly modify its walls. Under such circumstances, the roentgen examination will not demonstrate any changes. Bronchoscopy would yield valuable information and permit the removal of a specimen for histological study, providing such clinical phenomena be present as to suggest bronchoscopy. Such, however, is not the case. Tumors, particularly the parenchymal variety, give striking symptoms only after they have attained considerable extent, and even then, unless the tumor mass directly or indirectly affects the bronchus, the bronchoscopic examination gives no information. A routine bronchoscopic examination of every individual with pulmonary symptoms of any duration is not practical, but a roentgen-ray examination of the chest is. A careful study of the hilum and pulmonic field, repeated frequently when circumstances demand it, will bring us nearer the desirable consummation—the early diagnosis of pulmonary malignancy.

There are only two means by which such an early diagnosis may be made, conclusively—roentgen-ray examination and bronchoscopic examination.

X-RAY EXAMINATION

The roentgenologist does not primarily deal with the ultimate cellular structure of tissues.

The records of densities, called shadows, are interpreted by him in terms of gross tissue morphology. The diagnosis of carcinoma, fibroma, or sarcoma becomes possible only when the data furnished by the roentgenological examination are studied in the light of clinical and pathological knowledge. A roentgenological classification, therefore, is concerned at first with the shape, size, contour, location, and relationships of the shadows studied. When these

Fig. 21. A large alveolar carcinoma of the left lung. The shadow of the mass is sharply outlined except where it fuses with the shadow of the left hilum. There is a large circumscribed mass in the right lung. Smaller nodules can be seen in the right base.

Fig. 22. Diffuse small nodular metastatic carcinoma involving both lungs, the lesion showing confluence in the upper lobes.

have been classified according to certain criteria they are compared with the histological make-up of the structures responsible for them. It is thus found that shadows conforming to certain criteria are produced by one type of pathological process and shadows conforming to other criteria are produced by another type of pathological lesion. Where the pathologist is able to make a clear-cut differentiation and distinction, the roentgenologist may follow in safety, but where the pathologist hesitates and does not venture, the roentgenologist must tread warily.

It is usual, judging from roentgen literature, to attempt the differentiation between sarcoma and carcinoma and between primary and secondary lesions and to speak of the diagnosis in connection with these diseases as if it were possible always to determine accurately the specific cellular nature of these lesions. After all, as has been shown, the roentgenologist builds his structure upon the foundations laid down for him by the pathologist, and if the pathologist does not by gross—and cannot always indubitably by microscopic — examination stamp every lesion with its particular cellular construction, why should the roentgenologist attempt it?

The diagnosis of primary sarcoma is questioned by the pathologist for good and valid reasons, and if a rare case of tumor of mesoblastic origin is diagnosed by him only after careful histological studies, what basis has the roentgenologist for such a diagnosis?

As far as the roentgen appearance is concerned, the picture of the primary carcinoma of the lung may be exactly duplicated by a sarcoma, and a secondary nodule from a hypernephroma or a sarcoma may develop in an apex or base in the manner considered to be characteristic of a primary carcinoma of the lung. For this reason and others, the roentgenologist must frequently limit his diagnosis to the determination of the malignancy of the lesion as differentiated from a benign condition, and leave the diagnosis as to the primary and secondary nature and the cellular characteristics to be determined by the contributions of the clinician and the pathologist.

It is true that there are typical appear-

ances which are characteristic of primary and secondary tumors. The sowing of the pulmonic fields with numerous large and small, definitely circumscribed, rounded shadows, is a picture pathognomonic of secondary tumors. These, however, may be carcinomatous or sarcomatous. So, also, the miliary type of metastasis may be found with both primary and secondary lesions. This miliary carcinosis, or generalized pulmonary cancerous lymphangitis of the lungs, as it is called, may be present even in young subjects, secondary to a symptomless gastric carcinoma or to a hypernephroma.

Every type of visceral malignancy may produce pulmonary metastasis, and no inference regarding the extent, the duration, or the nature of the primary growth can be drawn from the pulmonary lesion.

It may be possible to differentiate between pulmonic metastatic tumors resulting from deposits carried by the blood stream (the miliary and nodular types) and those which are the result of direct extension from the primary tumor mass by permeation through the lymphatics. But the hilar type of tumor, involving the lower lobe, may—when it is a direct extension from a breast carcinoma—closely resemble the lesion which is apparently entirely primary in a lower lobe bronchus. It is true that sarcoma metastasizing in the lungs most often gives an extensive shadow in the lower pulmonic field, single, and having more or less the rounded form, and yet in the late stages of the disease (and this is when the roentgenologist usually sees the lesion), a carcinoma may give the same appearance.

Nor is the differential diagnosis between benignancy and malignancy always simple—from the roentgen findings alone. The clinical aspects of the case and the serial roentgen examination at intervals are frequently necessary for a clear differentiation.

Nevertheless, in spite of the limitations, the malignant tumors of the lungs in the stage when diagnosis is most difficult, namely, when the masses are small and centrally located, can be diagnosed roentgenologically more simply and with greater facility than by the usual examination. Besides this, the roentgen examination gives clearly the added information regarding the point of origin, the topographical distribution, the size, the direction of the extension, and the presence of complications—information which cannot be otherwise easily obtained.

The roentgen appearance is due to the following changes: (1) tumor; (2) stenosis—atelectasis; (3) inflammation; (4) necrosis; (5) cirrhosis; (6) pleuritis, fibrinous and exudative; (7) adenopathy.

TUMOR MASS

Confusion in description and classification has arisen from the fact that tumors in their various stages have been classified as distinct forms. If the study is made of these tumors in their incipient stage, there is no such great variability as when the tumor growth is well advanced.

(A) Hilar Tumors.—Bronchial epitheliomatous changes beginning in the secondary division of the bronchial system in the region of the hilum are made manifest at first mainly through an increase in the size and density and a distortion in the form of the hilum shadow. At some point in its contour this shadow loses the radiating form and increases in size and density. The point of confluence of the linear markings is farther out into the pulmonic field. The two main branches of the hilum shadow become spindle shaped and the angle normally formed by their junction is changed to a convex contour. The distortion of the hilum shadow and the agglutination of the markings leading to it, extends into the pulmonic field as the growth continues, while the peripheral pulmonic markings increase in size, density, and number *This is one variety of*

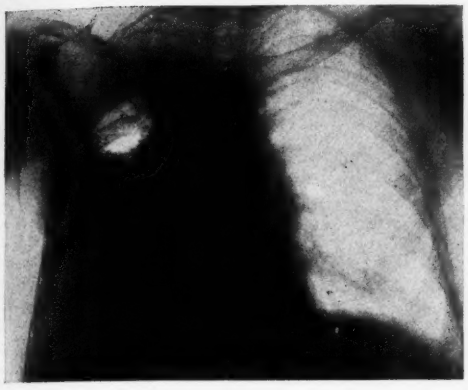

Fig. 23. Carcinoma of the left upper lobe. Necrosis with evacuation disclosed a large ragged-walled cavity.

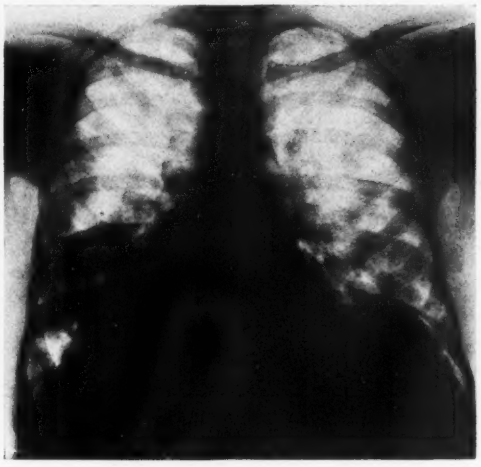

Fig. 24. Diffuse carcinomatous metastases of the large nodular type in both lungs.

roentgen picture associated with a growth in its early stage.

The asymmetrical enlargements and distortion of the hilum shadow may result in the formation of a definite triangular shadow. The lower border may be roughly convex and well defined; the upper border combed out and irregular, due to radiating markings, while the inner border may merge with the median shadow. The density is not homogeneous—small, denser areas may be visible within it. The apex of this triangle may point to any portion of the pulmonic field, depending on the particular bronchus involved.

Associated with this, there may be a rounded area of absent illumination with margins lacking sharpness through which the enlarged hilum shadow may be visible. This is the result of rapid perforation of the bronchial wall and infiltration of the parenchyma. Occasionally, along the course of the pulmonic markings radiating outward from the distorted hilum shadow, are small rounded disc-like shadows, sharply circumscribed and not very dense. These correspond to areas of tumor infiltration. This is another variety of roentgen appearance and corresponds to a well advanced infiltrating form of tumor.

There is a third variety of appearance which indicates the presence of bronchostenosis. The sharp pointed projection of an enlarged hilum shadow becomes rapidly obscured by a dense shadow, resulting from the blotting out of the illumination of a portion of the pulmonic field, due to atelectasis resulting from bronchostenosis. This gives a band of shadow across the pulmonic field, sharply bounded on one side by the interlobar fissure and on the other side merging gradually into normal illumination. This, too, may be found in any part of the pulmonic field.

On the other hand, the distorted hilar shadow may enlarge, due to the tumor growth itself, until it occupies a portion of the pulmonic field corresponding to a lobe. In the terminal stage the loss in illumination due to atelectasis cannot be distinguished from that due to tumor formation. The aortic or cardiac contours are not blotted out by the shadows due to these tumor formations or to the atelectasis.

When, as a result of direct permeation from breast carcinoma, the lungs are involved, it is usually in the form of a growth which extends to the hilum glands and then

Fig. 25. Gross appearance of a diffuse carcinomatous metastasis, showing the sharply circumscribed nodules (chorioepithelioma).

along the lymphatics into the parenchyma. These are classified as hilar tumors since they are connected to the hilar structures by strands of tumor tissue. Their appearance differs somewhat from the true hilar in that atelectasis is late or absent, and the pleural involvement is more marked.

There is a patch of absent illumination at the base of the lung connected to the somewhat enlarged hilum shadow by markings of increased size and density. The patch of absent illumination is roughly of rounded form, not homogeneous in density, the entire picture resembling a basal interstitial inflammatory condition. The discs of illumination corresponding to the secondary bronchioles are not seen, however. Pleural involvement rapidly increases the size and density of the area of diminished illumination. There are, thus, four variations of hilar shadow distortion produced by bronchial carcinoma.

(B) Parenchymal Tumors.—The parenchymal or alveolar tumors appear as discrete, sharply outlined, circumscribed, rounded or oval areas of absent illumination of the pulmonic fields. The increase in size of this shadow is concentric. The density does not depend on the size—a small nodule may have a greater density than a large mass. The illumination is completely blotted out, and the pulmonic markings about the tumor may not be increased in size or density, but there may be a sheaf of markings connecting it to the hilum, when the mass is in the median zone near the hilum. When the shadow merges with that of the mediastinal structures, it may, in the sagittal view, resemble that of the tumors of mediastinal origin, but in the lateral view the convex border of the mass may be differentiated from the hilar shadows. The shadows may occupy any or the greater part of both pulmonic fields, though the upper pulmonic field is the commonest point of location.

In apical tumors the deposit may be first noted in the second interspace and its genesis may stimulate the development of an exudative phthisical lesion, but the area of absent illumination remains discrete, circumscribed, and isolated and homogeneous, and is frequently of oval shape with its long axis parallel to the spine. A metastatic sarcoma and a primary carcinoma may give exactly the same picture.

Generally when single and isolated, the tumors are considered to be primary. When numerous and of varying size and found in both pulmonic fields they are secondary lesions. There are so many exceptions to this rule that extreme caution is necessary in venturing a diagnosis which gives information on this point. A single, isolated, sharply rounded tumor is not rare as a me-

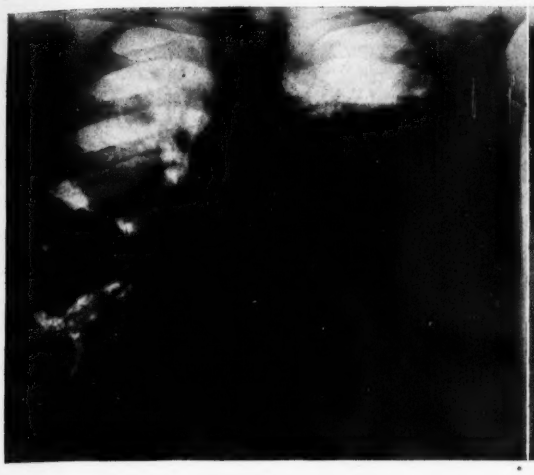

Fig. 26. Large metastatic sarcoma of the right lower lobe and numerous large nodular metastases in the upper lobe and left lung.

Fig. 27. Metastatic carcinomata of the large nodular type with a large mass at the root of the right lung.

tastasis from a neck or breast carcinoma. A single, large, circular, isolated, sharply defined shadow in one lung, for instance, may be the primary lesion of one or more relatively small oval or rounded shadows with hazy contours, diffusely scattered throughout the other field.

(C) Miliary Form.—The third form of carcinoma is produced by a carcinomatous infiltration of the pulmonary lymph vessels. In this variety the hilum shadow may show enlargement and distortion due to enlarged glands.

There are numerous pinpoint shadows diffusely scattered throughout both fields. These are discrete, isolated, dense, sharply defined. Not only is there increase in the size, number, and density of the pulmonic markings, but a fine network due to involved lymphatics and engorged veins may be seen.

A metastasis of the primary bronchial or alveolar carcinosis on one side may be miliary carcinosis in the other pulmonic field.

(D) Pleural Form.—Usually from the very first observation there is a complete obliteration of the illumination of one pulmonic field with the changes secondary to sclerosis and retraction. The examination may indicate fluid, the removal of which does not perceptibly influence the picture. The inference in these cases is a primary pleural disease—endothelioma of the pleura.

In rare instances it is possible to study the genesis of this type of lesion. An irregular, scalloped band of diminished illumination is first seen in the periphery of the pulmonic field. With this, there is an increase in size and a distortion in form of the hilum shadow, and then a general blotting out of the illumination and markings of the field.

STENOSIS

The bronchostenosis may be determined by direct and indirect signs. The direct sign is a deformity defect in outline and stenosis of the bronchus, as shown by intrabronchial lipiodol injections. The indirect sign lies in the atelectasis which is shown first by a diminution in the illumi-

nation corresponding to the occluded bronchus. Though usually only a smaller bronchus is involved, the main stem of bronchi of all three lobes may become occluded so as to produce a complete obliteration of the illumination of the whole field. This atelectasis varies during the progress of the disease and may diminish as the erosion of the bronchus or the necrosis of the mass frees the lumen and relieves the obstruction. The density is not marked at first; the markings may be discerned through illuminated areas, but, as the air is absorbed, or bronchiectasis and infection ensue, all details are lost in the field.

The diminution in illumination is at first not circumscribed nor sharply defined, but gradually merges into that of the normal field. It may be sharply bordered by the interlobar fissure, when the bronchus to but one lobe is occluded. In basal tumors the costophrenic space shows an absence of illumination not due to effusion but to atelectasis. The changes in the hilum shadow and pulmonic marking due to the actual size of the tumor may be seen through this unilluminated area. No inference as to actual size of the tumor can be drawn from the extent of the changes in illumination. In fact, even a very small nodule may, by completely obliterating the bronchial lumen, produce a marked change. With the diminution in illumination of the pulmonic field there may be a high position of the diaphragm, with impaired mobility of the whole or part, and an inspiratory displacement of the mediastinal contents toward the affected side.

The upward displacement of the diaphragm shadow may not involve the whole curve but only a segment—usually the anterior, the mesial portion.[6]

[6]The picture of atelectasis due to bronchostenosis may be produced by any process which closes the lumen of the bronchus—syphilitic stricture, pressure from aneurysm, tuberculous glands, mediastinal tumor, foreign body, etc.

INFLAMMATION

Infection produces a secondary bronchopneumonia which may involve the entire lobe, producing large or small areas of consolidation. These patches give shadows of varying sizes, consisting of a conglomeration of small rounded shadows centered by points of illumination. These are irregular in their distribution about the periphery of the shadow of the tumor. This complication is usually found with the hilar type of tumor and contributes to the make-up of the tumor shadow. This inflammatory lesion goes on to the formation of bronchiectasis, with interstitial changes.

NECROSIS

Destructive or necrotic changes resulting from circulatory or nutritive disturbances do not occur in sarcoma, for the fibrous tissue mass, which sometimes has a stony hardness, is not susceptible to degeneration or abscess formation.

The carcinomatous masses, however, are liable to degeneration and necrosis. Necrosis of the tumor mass, with gangrene and sloughing, produces a cavity which becomes infected, and converted into an abscess. The spreading of the infection to the surrounding lung tissue produces a complex picture often difficult to analyze. The evidence of tumor is to be sought somewhere in the wall of the abscess. The fluid line is rarely absolutely horizontal—an irregularity is present somewhere. The defect in its contour resembles that defect in the contour of the air bubble seen in carcinoma of the cardiac end of the stomach. The filling of the bronchi of the atelectatic lung with purulent material may cause a change in the contour of the lobe boundary. Thus the upper lobe may have a lower convex border.

CIRRHOSIS

The retraction and shrinkage of the atelectatic lung associated with the involvement of the pleura by tumor or fibrosis, and the pulmonary interstitial changes contribute to the obliteration of the illumination and of the markings and the production of static changes in the thorax. The mechanical consequences of compression are marked with sarcoma. The displacement of the tracheal band of illumination serves as an index to the degree of displacement of the upper mediastinal contents; the deviation of the heart shadow is an index of the displacement of the lower mediastinal contents. The atelectasis of large pulmonary segments, augmented by an obliterative pleurisy, may change the normal topography of the lobe and chest wall, with narrowing of the intercostal spaces and increased obliquity of the ribs.

The fibrosis of the pleura depends on the extent of the inflammatory or degenerative changes. Where there has been abscess formation, calcareous plaques may be found.

PLEURITIS

The pleura may be markedly thickened, even partially calcified and firmly adherent, not only parietally but to the mediastinum, producing distortion in cardiac outline and the retraction of the chest wall. Frequently there is complete obliteration of the illumination of the pulmonic field without much cardiac displacement, or there may be displacement to the side of the lesion in spite of the presence of fluid. This is due to a combination of atelectasis and effusion. When the tumor increases in size, the heart may be pushed to the opposite side in spite of the cirrhosis. The adhesions are more marked in the hilar than in the alveolar tumors.

Early or late, pleural effusion (serosanguineous or purulent), due to pleural metastasis or pressure at the root of the lung, is a common finding. The effusion may occupy the anterior, lateral, or vertebrocostophrenic space, rarely the interlobar space, and may clear up without treatment as the disease progresses. There may already be the typical costophrenic shadow before the tumor has produced any extensive atelectasis.

The large effusions may depress the diaphragm. The fluid may compress the atelectatic lung—so that it occupies but a small area at the base of or against the spine, dimly visible through the defectively illuminated area. The outline of the tumor is usually, however, hidden by the fluid, if the examination is made in the sagittal position. In the lateral view it is, however, possible frequently to make out the tumor. The induction of pneumothorax is not usually of any great assistance in permitting an easier analysis of the shadow complex.

ADENOPATHY[7]

Glandular involvement is more extensive in secondary lesions than in primary. The entire mediastinal chain may be involved, producing an enlargement and distortion of the hilum shadow.

The involvement of the glands may result in the production of large nodular masses either in the anterior or posterior mediastinum and about the great vessels, the mass including the involved bronchus. Glandular enlargement is not to be diagnosed on a mere distortion of the hilum shadow. These shadows of enlarged glands

[7]The pulmonary lymphatics follow the bronchial tree branchings, anastomosing freely, especially at points of division of the bronchi into the bronchioles, where the pulmonary lymph nodes are located. The pleural lymphatics anastomose with the pulmonary channels in the interlobar septa. The invasion outward from the hilum along the interlobar fissure, through these lymph channels, is seen not only in carcinoma but also in Hodgkin's disease, and explains the triangular tongue-shaped form of the lesion.

are definite. They have a definite shape and contour and a definite site and a characteristic appearance. On the left side, the lymph node mass is seen as an oval shadow just below the arcus of the aorta, its axis directed upward and slightly outward. The central mass is usually not seen unless the enlargement is marked, and the lower is hidden by the heart. On the right side, the three rounded masses may be isolated. The supraclavicular, axillary, and sub-maxillary glands may be involved, or lymph nodules may be found in the bony thorax. These may be made out as definite shadows in the soft tissue structures.

DIFFERENTIAL DIAGNOSIS

The roentgen appearance of the different types of malignant tumors varies definitely at different stages of growth, and thus it comes to resemble in its various phases a variety of other pulmonary lesions.

For the purpose of differential diagnosis, therefore, the periods of growth of the hilar and alveolar tumors may be divided into three stages: First, the incipient; second, the florid; third, the terminal. The diseases which need to be differentiated from tumor growths at various stages may be classified as follows:

Hilar Tumors

Stage

Incipient—to be differentiated from
- Adenopathy
  - Tuberculous
  - Hodgkin's
  - Sarcoma
  - Carcinoma
  - Infarct

Florid—
- Consolidation
- Interlobar effusion
- Interstitial inflammation
- Tuberculosis
- Syphilis

Terminal—
- Fibrosis
- Effusion

Alveolar Tumors

Stage

Incipient—
- Acinous nodosal phthisis

Florid—
- Pulmonary Hodgkin's disease
- Syphilis

Terminal—
- Cysts
  - Dermoid
  - Teratomatous
  - Echinococcus
- Benign tumors

Miliary Carcinosis

- Pneumoconiosis
- Miliary tuberculosis

Pleural Carcinoma

- Fibrosis
- Effusion

The clinical history plays a most important part in the differential diagnosis, particularly in the differentiation from inflammatory lesions and benign growths. In the former, it is very helpful except where the inflammatory lesion is a complication or sequel of pulmonary malignancy, and, in the latter, it may be of great importance in spite of the fact that pulmonary malignancy frequently gives no striking symptoms.

The repeated or serial examination at intervals for the purpose of studying the velocity of the various morphological changes, the appearance of secondary lesions, complications and sequelæ is extremely important. It is not always possible to determine at the first examination the exact nature of the shadow, even with the aid of the clinical history.

In the incipient stage, the slight distortion of the hilum shadow may require dif-

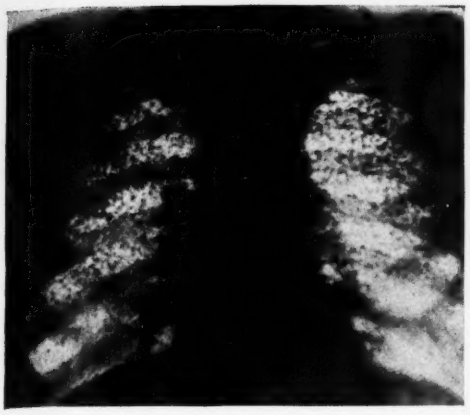

Fig. 28. Diffuse calcified miliary metastasis (thyroid malignancy).

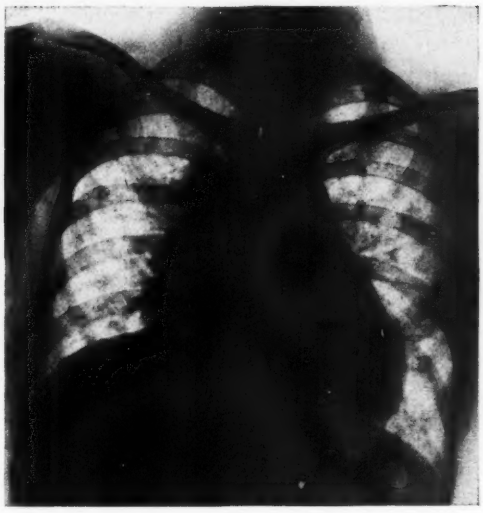

Fig. 29. Carcinomatous infiltration of the hilum and pulmonary structures, secondary to a carcinoma of the right breast.

ferentiation from those diseases in which there is involvement of the tracheobronchial and hilar lymph nodes, namely, tuberculosis, Hodgkin's disease, lymphosarcoma. As a rule, however, these adenopathies are bilateral and fairly symmetrical. Their shadows are definitely circumscribed, lobulated, with convex smooth borders, and located in positions which may be topographed within narrow limitations. There is a type of bronchial carcinoma in which a small nodule, producing atelectasis early, may resemble the picture of an infarct.

An infarct may give a dense triangular shadow with sharp margins which usually extend outward from the hilum across the pulmonic field. The base of the triangle is at the hilum, the apex in the pulmonic field. Associated with this there are evidences of diffuse congestion of both lungs. The lesion generally clears up, leaving slight fibroid changes. The diaphragm is elevated, particularly laterally, and is relatively immobile.

In the florid stage, when the tumor growth has advanced to the point of being able to produce its sequelæ and complications, the atelectasis resulting from bronchostenosis may obliterate the illumination of the pulmonic field in such a way that the appearance resembles that produced by consolidation or interlobar effusion. The bronchiectasis and the resulting pleural involvement may hide the causative factor—the bronchial newgrowth.

There are cases of pulmonary malignancy which simulate an acute respiratory disease so closely as to lead to errors in diagnosis. The symptoms accompanying pulmonary metastasis may be mistaken for the systemic manifestations of a mild respiratory infection, or a sudden onset with fever, pain in the chest and weakness, dyspnea, and evidences of obstruction of the pulmonary circulation may suggest a lobar pneumonia or bronchopneumonia, acute pleurisy, empyema or tuberculosis.

It may be that in many of these cases a true pneumonia develops in the lung, the seat of malignancy, the latter having existed without symptoms. On the other hand, the reactive inflammation which is set up in the lung may be the direct result of the tumor, or the exudative pneumonic inflammation is an intercurrent infection and prepares the soil for the growth of the metastasis.

That acute pleurisy is often simulated by the metastatic pulmonary growths has long been known. The dyspnea from a hemorrhagic pleural effusion secondary to a tumor may appear very suddenly and prove rapidly fatal.

In the differentiation of this disease, malignancy, the history is a confusing factor. The physical signs are of no value in disclosing the true condition, and diagnosis depends, therefore, entirely on the roentgen examination. But the roentgen examination may show only an area of consolidation, usually in the base of the lobe, commonly in the right upper, the consolidation obscuring the evidence of tumor formation so that distinctive markings of the tumor are absent. However, repeated examinations do not show the usual resolution of the area of pneumonic consolidation, and the clinical course, in conjunction with the findings, determines the diagnosis.

The differentiation from pulmonary tuberculosis will seldom be difficult. In the ordinary exudative phthisis the upper lobes, especially the apical periphery, are the common locations of the small areas of diminished illumination, with very few, if any, changes in the hilus. Analysis will show the characteristic discs with pinpoint centers of illumination. Cavitation may be present and there is frequently an associated localized retraction due to the pleuritis. In the acinous productive (miliary) and nodosal types, the individual areas of increased density are smaller, more regular in shape, more discrete, more uniform in size, and with greater peripheral involvement than in the miliary type of carcinoma. The nodular productive lesion is rarely pure. There is usually a tell-tale exudative lesion in the same or the opposite lung.

The miliary tumor deposits are more marked in the lower lobes, and show a tendency to confluence. The hilum shadows in miliary tuberculosis are, as a rule, well defined, and, if enlarged, clearcut and definite.

There may be combined tumor and tuberculosis. The finding of acid-fast bacilli in the sputum of a patient with gangrenous processes in the lung due to a carcinoma may lead to the wrong diagnosis of pulmonary tuberculosis.

Metastatic tumors may contain calcific inclusions like tuberculous foci. Large carcinomas produce more rapid secondary changes—cirrhosis, retraction of the thorax and the intrathoracic organs—and these changes may be entirely out of proportion to the extent of the tumor mass as first seen.

Cavitation may be found in both lesions. The tuberculous cavity is more frequently multiple, clearly defined, more regular in outline, with a thin, well defined wall; while the tumor cavity appears as a central point of illumination in a dense and large shadow, the walls are irregular, and there is no zone of characteristic reaction about it.

So also in the differentiation of pneumoconiosis from malignancy, the enlarged and distorted hilum shadows, the miliary deposits, and the fibrosis make a picture which requires careful analysis. The tendency to fibrosis and calcification is a feature so characteristic of pneumoconiosis as to simplify the problem.

Interstitial inflammatory lesions with bronchiectasis may rarely be confused with pulmonary malignancy. The only type which at all presents a picture similar to that of lung tumor is that severe form which involves the middle lobe of the right lung, or the basal portion of either lower lobe. The exudative and productive changes about the hilum may be so marked as to obliterate all the markings and illumination in this region, while the bronchiectatic cavities filled with secretion and the marked pleural fibrosis may increase the area of deficient illumination to a considerable extent.

Fig. 30. Malignancy of the thymus gland. No metastatic pulmonary lesions.

Fig. 31. Large mediastinal lymphosarcoma. The shadows of the rounded masses extend into every portion of the pulmonic fields.

The maximum area of the shadow is not central as in the hilar tumors, but peripheral. The outlining of the bronchiectatic cavities by the injection of a contrast medium and the absence of any progressive invasion will clear up the diagnosis.

In the terminal stage, the retraction of the lung resulting from the atelectasis, pleural involvement, and fibrosis will result in a complete obliteration of the illumination of the pulmonic field, with displacement of the mediastinal structures to the side of the lesion.

The differentiation from carcinoma can be made only by referring to the clinical history. The occasional presence of a small focus of metastasis in the opposite lung may give a clue to the nature of the lesion.

The early pulmonary abscess, as a rule, presents no problem in differential diagnosis; but the abscess which has existed for some time, in which the reactive inflammation has disappeared, may closely resemble a broken down alveolar tumor.

Exploratory puncture when the abscess does not communicate with a bronchus as shown by the absence of a fluid level, will withdraw pus. This withdrawal of the pus is important, not so much *per se* (though this may show evidences of pulmonary tumor) as because of the admission of air, a phenomenon which always takes place. It now becomes possible to examine the walls which enclose the fluid, for, by tilting and examining in various postures, successive portions of the wall may be scrutinized. In abscess, the wall is clearly defined, thin and smooth. The fluid level always extends from wall to wall, and is always a straight line. In tumor, on the other hand, the fluid line is at one point or another, irregular, and not horizontal. In other words, just as in carcinomas of the cardiac end of the stomach there is a defect in the form of the gas bubble, so here a defect in the formation of the air bubble picture may be made out, due to invasion of the wall of the abscess by tumor formation. The air bubble is no longer a complete semicircular shadow, but the contour of the shadow is broken by an irregularity at one point or another.

The thoracic manifestations of Hodgkin's

disease require differentiation from pulmonary malignancy. The massive enlargement of the lymph structure producing a mediastinal tumor, does not offer any problem of differential diagnosis, but the marked lateral widening of the upper part of the median shadow with its clear, well defined borders, with normal pulmonic fields, is characteristic. The infiltrative type, in which the lymphomatous masses appear to extend into the pulmonary tissue from the hilum, and the nodular form, with isolated nodules in the parenchyma, give a picture which may strikingly resemble a pulmonary malignancy, the former the hilar type, and the latter the parenchymal type. Associated with the infiltrative lesions, which are usually bilateral, are lymphomatous masses at both roots. The nodular type of disease gives shadows more irregular in contour and density than pulmonary tumors.

The shadows of the discrete nodes of Hodgkin's disease enlarge and distort the hilum shadow sharply and definitely. The radiating form of the hilum shadow is changed to a rounded or lobulated shadow. These large lobulated hilum shadows are faint and homogeneous and do not have the dense irregular outline due to a bronchial carcinoma. The entire hilum shadow is involved—not one portion of it. There is no tendency to caseation and calcification.

The test of treatment is an important differential point. The reactions of lymphomatous masses to radiation is so marked and decisive as to offer a means of differentiation. A partial erythema dose causes a rapid change in size and number of these masses within a few days. Many disappear completely, others recede with astonishing rapidity, and the general condition improves in a remarkable manner. Such a reaction is not observed with metastatic or primary carcinomatous tumors.

The benign tumors may for many purposes of differentiation be divided into solid masses,[8] teratoma, fibroma, adenoma, melanoma, without definite form, and the cystic tumors, usually spherical, as the dermoid and echinococcus cysts.

Hydatid or echinococcus cysts are usually basal and single, though they may be symmetrical and double. The shadow of such a cyst is usually clearly defined, sharply circumscribed and outlined, and circular in form. The wall of the cyst may show as a ring of increased density.

The multiplicity of the lesion, the continuous irregular extension without sharp boundaries, the radiating lines of invasion, the presence of complication, as effusion and bone involvement, will differentiate a malignant lesion from a benign growth, with its sharply circumscribed contours, its slow growth, and its relatively slight disturbance of general health.

Generally speaking, the mediastinal shadow is unchanged in pulmonary malignancy and such deviations as take place result from neoplasms originating in the loose connective tissue of the mediastinum, in the peribronchial and mediastinal lymph nodes, and in the thymus, and give shadows which are bilateral. Thus the differentiation from mediastinal tumors[9] offers no difficult problem.

Carcinoma of the mediastinum arising from the epithelium of the esophagus, the trachea, the bronchi, and the thymus, or from the misplaced or accessory thyroid gland, may, in its early stages, give a distortion of the hilum shadow such as is due to a primary bronchial carcinoma.

Cysts, either simple or dermoid, occur within the mediastinum. The walls of the dermoid cyst may contain fragments of

[8] Chondroma and osteoma, springing from the under surface of the costal cartilages or sternum or from the posterior surface of the vertical column, may be included in this category for the purpose of differentiation.

[9] Excluding aneurysm, tumors of the mediastinum may be classified as primary or secondary, malignant or benign. Almost every type of tumor may be found in the mediastinum, fibroma, lipoma, chondroma, osteochondroma, myoma, sarcoma, carcinoma, simple cyst, dermoid cyst, teratoma, hydatid cyst and syphilitic gumma. Intrathoracic goiter may be considered as a tumor of the superior mediastinum.

bone, of cartilage, of teeth, and of gland tissue. Pulmonary tuberculosis may be associated with the presence of mediastinal dermoid cysts. The condition may resemble pulmonary tumors.

The mediastinal teratomas occur in young adults, the symptoms first manifesting themselves shortly after puberty. These tumors consist of solid masses of tissue containing many small cysts. The stroma between them is composed of muscle, fat, cartilage, bone, fibrous tissue, and neuroglia.

Intrathoracic goiter is frequently found in the superior mediastinum. This may be an extension from the lower pole of the lateral lobe of the isthmus of the thyroid, or it may develop from an accessory thyroid gland. The clinical history and the serial examination must determine the diagnosis.

The syphilitic pulmonary lesions of the lung, which occur more frequently than is generally supposed, must be ruled out in the consideration of pulmonary malignancy. The latent nature of the disease, giving, as it does, but few manifestations, is responsible for its late recognition. Usually the lesion is not discovered except in the course of examination for disease of the cardiovascular system, liver, or bony thorax. When found, the diagnosis is not easy because syphilis simulates many other pathological conditions in the lung and gives in none of its manifestations any appearance which is characteristic. Thus not only incipient, but even well marked, lesions are not recognized. The test of treatment is by no means conclusive for there is no reason why a syphilitic cannot have a tumor of the lung, and non-syphilitic pulmonary suppuration is frequently helped by salvarsan.

The association of syphilitic lesions in other tissues is, of course, helpful in the establishment of diagnosis. Thus, associated with the lung lesion, there may be an aortitis, gummata of the clavicle, ribs, and sternum. The gummatous process may extend from the liver through the diaphragm and ribs. The differential diagnosis becomes important, because of a great similarity of the symptoms. Cough, expectoration, dyspnea, hemoptysis, and loss of weight are symptoms which characterize syphilis also. There is no roentgen appearance characteristic of syphilis of the lung.

Syphilitic lung lesions may be (1) gummatous, (2) pneumonic, or (3) interstitial inflammation, (*a*) with fibrosis, (*b*) with bronchiectasis and necrosis (gangrene).

As seen in practice, the disease usually consists of a mixture of all the types above given. Gummata may show as irregular or round circumscribed shadows, usually in close relation to the hilum shadow. The center of the disc may show, because of the necrosis, slightly more illumination in the periphery. In many cases, the lesions are extensions from, or associated with, gummata of neighboring parts.

The syphilitic bronchopneumonias show as patches of infiltration, irregular in outline, confluent, with a very indefinite outline, and are confined to the bases.

The interstitial inflammation with bronchiectasis, cavitation, gumma formation, and necrosis is a picture with no characteristics to stamp its true nature. The lesion is to be differentiated from the primary hilar carcinomas. The lesions in syphilis, instead of radiating outward from a portion of the hilum, as a rule involve simultaneously all parts of the hilum shadow. The presence of gummata magnifies the hilum shadow, and the interstitial inflammation produces an increase in the size and density of the pulmonic markings which show as radiations in all directions from the median shadow, but sometimes most marked towards the base.

The terminal stage of these lesions is a pulmonary sclerosis or syphilitic fibrosis.

This condition is the terminal stage of all syphilitic pneumopathies.

These fibroid changes may be visualized as a network in the lung parenchyma produced by a thickening of the connective tissue of the bronchi, vessels, and the interalveolar septa, existing chiefly in the interalveolar and interlobular septa and in the adventitia of the vessels. The radiations of the fibrous tissue from the hilus follow the bronchi. The induration of the surface of the pleura by bands of fibrous tissue running on the surface and deeper, produce lobulation and furrowing analogous to syphilitic liver. These changes show as an increase in the number and density of the pulmonic and interlobar markings in the pulmonic field, and a network of linear shadows. But the dense fibrosis of the lung and pleura, with retraction of the heart and mediastinal contents, soon obliterates the illumination and thus the differential diagnosis from the terminal stages of pulmonary tumor cannot be made.

It is thus obvious, since the symptoms of pulmonary carcinoma are not characteristic and moreover relatively late in their appearance, and since physical signs are neither characteristic nor striking, that the corroboration of a clinical suspicion should be promptly sought, through the roentgen examination or bronchoscopy. In the determination of the gross physical characteristics of the tumor and its relation to the pulmonary parenchyma, the X-ray examination is of paramount importance.

The roentgenologist should seek, particularly in individuals of the cancer age, in the enlargement or distortion of the hilum shadow and in circumscribed areas of defective pulmonary illumination for the first signs of pulmonary invasion.

DISCUSSION

Dr. L. T. LeWald (New York): I have not anything to add except to confirm what the reader of the paper, Dr. Hirsch, said about the inability to make a diagnosis of lung tumor by physical signs in the early stages; also to confirm the fact that bronchoscopic examination is, at times, capable of making an early diagnosis, before there is roentgenographic evidence. That has been shown by Dr. Chevalier Jackson in two or three very striking cases, particularly brought out on the radiograph afterwards by the insufflation of an opaque substance coating the tumor projecting into the bronchus. There is one procedure that Dr. Hirsch did not mention. Occasionally, in the type of tumor which he said was sheathing the pleura, it may be essential, if fluid is present, to withdraw some fluid and *introduce some air* to make a contrasting medium, and thus show the projecting mass of the tumor, distinguishing it from a simple effusion or some other condition of the lungs or pleura.

As he has stated, the recognition of these lung tumors is being rapidly brought forward, and I would say that the surgeon, especially the thoracic surgeon, stands ready to operate if we can make an early diagnosis, and there are now increasingly larger numbers of cases that have been successfully operated upon where the roentgen diagnosis was made early.

Dr. C. G. Sutherland (Rochester, Minn.): There are one or two points I should like to emphasize in discussing Dr. Hirsch's excellent paper. One is the necessity of close co-operation between the roentgenologist, the clinician, and the thoracic surgeon in primary malignancy of the lung and bronchus. Probably some of the best results in the diagnosis of these conditions have been through such co-operation. Correlation of the clinical manifestations and the roentgenologic findings should especially be stressed.

As Dr. Hirsch has pointed out, some of the roentgenologic signs result from reaction

to the tumor, the tumor itself not being apparent in the roentgenologic plate. A picture sometimes difficult to distinguish from that of bronchiectasis or abscess, associated with extreme dyspnea, should make one think of primary carcinoma of the bronchus. In such cases we suggest bronchoscopic examination.

Since the establishment of the thoracic section, with close co-operation of the roentgenologist, the clinician, and the surgeon, we have found primary carcinoma of the bronchus to be more frequent than we had supposed it to be. In the Clinic, we have seen sixteen cases of primary bronchial cancer since August of this year [1926].

Dr. E. E. Mansur (Jefferson City, Mo.): The question of unresolved pneumonia came to my mind when I saw the first two or three slides Dr. Hirsch showed. In at least two of those first three, I believe the case could be easily taken for one of pneumonia. Some two months ago I had occasion to see a case of unresolved pneumonia, some two and a half months after the pneumonia—and I might say that it was a very mild, almost symptomless pneumonia this man had. This case showed a definite pneumonia still present two months and a half after the incidence of the disease, and the patient was up and about and had very little temperature reaction—I do not think his temperature was more than one degree rise in the afternoon. In other respects the case was perfectly normal and there was no evidence of tuberculosis or anything of that nature. X-ray treatment of the pneumonia caused its rapid disappearance.

Dr. W. H. Wallace (Brooklyn, N. Y.): In the paper I read the other day I tried to point out that carcinoma of the lung or any other malignancy of the lung is practically always in the mediastinum. Dr. Hirsch has not shown us a plate (with two possible exceptions) where that was not true, and he did not show any lateral slides of those two cases, so we do not know that the malignancy did not spring from the mediastinum in those cases also. I remember ten years ago being asked to come over to the Jewish Hospital in Brooklyn to look over a lung case because they were going to do a bronchoscopic examination. They thought they had a foreign body down in the bronchus and asked me what I thought about it. I said it looked like some kind of growth and not a foreign body. After the bronchoscope was inserted, they found some little granulomas down in the bronchus. Some of these were removed and an examination made and they were found to be of the epitheliomatous type. A few days after that was done, a lateral plate was made that showed there was a large number of grains, or whatever you choose to call them, in the mediastinum.

Now, I think this contribution of Dr. Hirsch is a very valuable one. We have to be on the watch for these things, but I do not know what we are going to do about them after we find them, for these patients who have come under my observation have gradually passed on. I think, from what Dr. Hirsch has shown here, that most of these cases have gone on to a final bad result.

Dr. Hirsch (closing): In reference to Dr. LeWald's question as to the aid which an induced pneumothorax may render to simplify the diagnosis I desire to state that I have not found the procedure of much help. The pleura is usually the seat of adhesions in these cases and collapse of the lung does not take place readily and, even should partial retraction take place, no greater detail is evident.

In regard to Dr. Sutherland's remarks, I desire to make clear that the criticism I have made is by no means to be taken to refer to such a group of enlightened clinicians as

they have at the Mayo Clinic. There is no doubt but that by proper team-work a great deal is to be accomplished in roentgen diagnosis, but the roentgenologist's viewpoint is not always respected or welcomed everywhere.

Dr. Mansur's remarks bring up a very important point. I did not have the time to speak of it, but have referred to it in the paper. Very often the first striking clinical phenomena of a lung tumor may closely resemble and be those of a typical pneumonia. The pneumonia develops in a lung which is the seat of a silent lung tumor, and thus for the first time attention is called to the lung lesion. The clinical course, however, discloses the fact that it is not a true pneumonia. In other cases the pneumonia seems to prepare the soil for the growth of a tumor. Empyema in elderly persons should always be considered with suspicion as being possibly due to a broken-down pleural or lung tumor.

I am sorry I cannot agree with Dr. Wallace. I noted this statement when he read his paper. There is, to my mind, no question but that there do occur cases, and I have seen them at autopsy, where the tumor is entirely parenchymal and has no apparent connection with the bronchus. This can be demonstrated radiographically by oblique or lateral examinations, which show a definitely circumscribed, sharply outlined, clear-cut, rounded tumor in the central part of the pulmonic field bearing no intimate relationship to the hilum. This type of tumor is not as common as the bronchial carcinoma.

EPIPHYSEOLYSIS[1]

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"EPIPHYSEOLYSIS," slipping epiphysis or acute epiphysitis, epiphyseal coxa vara, is a condition the etiology of which is uncertain. It is claimed by many to be due to an endocrine disturbance. The condition is also attributed to slight, oft-repeated trauma. It occurs more commonly in children at adolescence. It results pathologically in a softening and separation of the epiphyseal cartilage, causing the head of the femur to separate from the neck. When the separation of the head is reduced and maintained in the normal relation to the neck it becomes re-attached again. It often leads to a moderate coxa vara. It is associated symptomatically with considerable pain, muscle spasm, muscular rigidity, external rotation and adduction of the thigh. One hip is most commonly involved, but the separation may be bilateral.

Etiology.—Most observers attribute this condition to an oft-repeated slight trauma. The traumatism loosens the epiphyseal plate and causes the head to separate from the neck by muscular action. Wilson (1) in a report of seven cases states that a predisposition to separation is present, but the exciting factor is trauma. Displacement occurs at a later date as a result of continued use and the shearing strain of body weight. Whitman (2) states that epiphyseal fracture is extremely uncommon in childhood because the junction of the head and neck is protected by a thick covering of cartilage which becomes progressively thinner as the area of ossification enlarges preparatory to final calcification; and, further, states that in bilateral separation of the epiphysis a constitutional predisposition is present.

Liek (3) maintains that a spontaneous separation is brought about because the epiphysis is changed by disease. In addition, experiments on cadavers and on animals have shown that there is a surprising firmness of the cartilage near the joint.

Schmidt (4), in tracing back some of his cases, believes trauma to be a far-fetched theory, because in most of his cases the separation had occurred months after the injury.

Although epiphyseal separation may be attributed to trauma, it is not the cause which leads to the pathological changes that are found in these cases. The underlying cause must be sought in a constitutional disturbance, *and most likely in a disturbance of the glands of internal secretion.* The reasons for this speculative theory are: first, that the separation occurs in children at the age of adolescence; second, that both hip joints are often involved at the same time; third, that it occurs in over-developed obese children, and lastly, because it is often associated with a family history which leads to an undermined physical development.

Trauma was a debatable question in two of our cases. The separation of the heads of the femurs occurred when the children were in bed and under observation. In one case there was a separation of the heads of both femurs at the same time. The other case recovered from a unilateral epiphysitis and one year later presented symptoms in which the other hip was involved. If the shearing strain of body weight can be considered on the basis of trauma, then the separation of the one hip occurred as a result of use.

Insofar as the history of trauma is seldom, if ever, clear, the following theory seems logical to advance against trauma as a factor in the production of these derange-

[1]Read before the Radiological Society of North America, at Milwaukee, Wis., Dec. 3, 1926.

Fig. 1. Right hip of Case 1, showing separation of the head, with a narrowing of the neck of the femur.

Fig. 2. Radiogram of the left hip showing almost complete separation of the head from the neck. There seems to be no involvement of the acetabulum and no erosion of the articular surface of the head.

ments: The patient or parents may have only a vague idea about some slight fall or seemingly insignificant injury at some remote time. A number of young individuals have oft-repeated injuries to their extremities without any consequences. Separation seldom, if ever, occurs as a result of hip joint reduction where extreme force and leverage are employed. Fracture of the femoral neck has occurred, but no separation of the head. Spontaneous separation of the head of the femur does not take place in cases of Legg-Perthes' disease where a circulatory disturbance is present. In the early stages this condition is often mistaken for Legg-Perthes' disease, but as the case advances there is no question as to the diagnosis.

Key (5) states that it is not to be denied that trauma often inaugurates the symptoms in epiphyseal coxa vara, and, further, that it is essential to know whether or not the upper end of the femur was normal when the trauma caused the epiphyseal separation. If the degree of trauma encountered in the average case of epiphyseal coxa vara were sufficient to cause epiphyseal separation in the normal adolescent, then epiphyseal coxa vara would be almost universal, because the average adolescent suffers a number of such injuries early in life. He disposes of the static theory bringing about epiphyseal separation with the statement that, if true, then practically all cases of epiphyseal separation would be bilateral, just as cases of rachitic coxa vara are bilateral.

In epiphyseolysis the superincumbent weight is important, and with the aid of muscle pull determines the direction in which the epiphysis moves; there must, however, be a lessened resistance. The obvious factors, therefore, which determine epiphyseal separation are trauma and static influences, but it must be recognized that a diseased condition of the epiphysis exists.

Clarke (6) gives a detailed account of a case which was treated in the City Orthopedic Hospital in London. The patient was a girl, 15 years of age, who fell, injuring her hip. An open operation was performed several months later and an account is given

of the pathology. He states that "the parts removed consisted of the head of the femur (which was entire). The head had remained connected with the neck by two portions of cervical ligament. The ligamentum teres was also intact. By these connections it had escaped necrosis but there was no attempt at bony union, the callus having been formed entirely from the neck of the femur. The separation had taken place exactly in the plane of the epiphyseal cartilage, *no trace of which remained.* The fragment of the neck which was removed was somewhat sclerosed."

Mechanism.—As a result of the softening that occurs at the epiphyseal line and due to vascular changes loosening the firm periosteal attachment, the neck of the femur is displaced upwards and rotated outwards by the strong muscles that are attached to the lesser and greater trochanters. The head of the femur remains in the acetabular cavity, but is rotated backwards and downwards. As the disease progresses and a reduction has been accomplished, the limb remains slightly everted and a moderate amount of adduction persists.

Radiological Evidence.—The early roentgen picture of epiphyseolysis is very uncertain. The epiphysis seems somewhat wider, with a very slight decrease in the density of the head and neck of the femur at the epiphyseal line. The head of the femur suggests a closer approximation to the acetabular cavity, with the articular surface unchanged. However, at the lower epiphyseocapital margin there is an area the size of a pea, which is rarefied and suggests an osteomyelitic process.

As the process extends, this area becomes definitely rarefied and appears definitely circumscribed. We have been unable to demonstrate an intermediary stage between the foregoing and that of a complete separation, which is evidently spontaneous, permitting the neck to slide upwards along the capital epiphysis to its uppermost limit, where, on account of the adducted position of the femur, it remains an unbroken line with the head. The head is slightly rotated backwards and downwards, while the neck of the femur is rotated outwards and appears to have been pulled upwards and wedged into the upper half of the head. The neck appears increased in diameter at the epiphyseal end and is regular in outline at the margin. The appearance of the head and neck at their junction makes it seem as if the cementing elements were melted away. The head, on account of its rotation, appears cup-like and is decreased in width at the superior half, assuming a semilunar or beak-like character, or appearing like a widened and broadened inverted comma extending below the lower margin of the neck. The neck of the femur appears longer than normal, due to the absence of the head and on account of its rotation, and it is rounded off at the epiphyseal margin. It is difficult to say whether the epiphyseal plate adheres to the head or neck or if both displaced surfaces are covered by epiphyseal cartilage, or if the cartilage is entirely gone. Clarke states that in a specimen removed at operation no trace of the epiphyseal cartilage remained.

When a reduction has been successfully accomplished the head appears in normal relation to the neck. There are certain changes that invariably follow. These are bone-productive changes with the concomitant development of coxa vara. The head is not changed in the same manner as that which occurs in Legg-Perthes' disease, in which the head and neck of the femur are broader and mushroom-shaped and the head's relation to the neck unchanged, whereas in epiphyseolysis the head is rotated and appears displaced downwards. The greatest amount of bone-production is seen on its lower inferior surface. The late cases of epiphyseolysis are difficult to dif-

ferentiate from a healed Legg-Perthes' disease.

Diagnosis.—In the incipiency, before there are well-defined roentgenological findings, it is very difficult or impossible to make a diagnosis of the condition. The presence of a beginning epiphysitis is suggested when a young adult suffers from an acute pain in the hip joint, or, what is more usual, a pain in the knee with a *progressive development of disability.* Upon examination it may be found that adduction, external rotation, slight flexion, muscular rigidity, muscle spasm, shortening of the extremity, and a limitation to abduction have taken place and the X-ray will reveal a slight loss of density of the head of the femur, a widening of the epiphyseal line, and a slight rarefaction around the epiphyseal portion of the neck. When separation of the head has occurred the diagnosis is not difficult.

DIFFERENTIAL DIAGNOSIS

A. Acute Processes.—The conditions from which this disease must be differentiated are:

1. *Acute Septic Epiphysitis.*—This disease occurs more commonly in children between the ages of two and five. It is associated with a moderately high temperature, leukocytosis, and the general symptoms of an acute septic process. The extremity is *abducted and externally rotated.* There is a marked tenderness and enlargement of the thigh but no shortening. There may perhaps be a slight amount of fluctuation. The roentgenogram will reveal an erosion of the articular surface of the femur. There may be a stripping of the periosteum along the neck, extending down to the shaft of the femur, with displacement of the head from the acetabular cavity. There will be no separation, but a destructive process of the head. Often one can see a definite infiltration of the soft parts and abscess formation.

2. *Tuberculosis of the Hip.*—Early in the disease the acute symptoms may simulate epiphyseolysis. The roentgenogram will establish the diagnosis. The early symptoms in tuberculosis of the hip are: pain radiating to the knee joint, a well-defined limp, adduction, flexion, and internal rotation of the thigh. This is in contradistinction to epiphyseolysis, in that in the latter there is adduction and external rotation of the thigh. The other outstanding symptoms in tuberculosis of the hip are the marked muscle spasm and the persistence of pain after an immobilization is accomplished.

3. *Fracture of the Hip.*—This occurs rarely in children and can be differentiated only by a roentgenogram. In fracture of the hip there is always a history of a definite traumatism and immediate complete disability.

B. Chronic Processes.—The first to be considered is Legg-Perthes' disease. The age incidence is of importance because Legg-Perthes' disease usually occurs in children younger than ten years of age, while epiphyseolysis occurs in young adults. The X-ray evidence in Legg-Perthes' disease is primarily a change in the head of the femur. The head is not displaced but is deformed, often assuming a mushroom-shaped appearance. The head appears to over-grow upon the neck. The head is flattened and broadened and approaches the greater trochanter. The upper border of the neck is shortened.

CASE REPORTS

Case 1.—V. M., a girl 11 years of age, was admitted to the Michael Reese Hospital in June, 1919. The patient complained of inability to walk and severe pain in both hips and thighs.

Onset and Course.—Patient was well until five weeks prior to her admission, at which time pain developed in the left thigh

Fig. 3. Case 2. Shows a separation of the head from the neck in the left hip joint. The epiphyseal line is perfectly even. The head is displaced downwards and backwards. The upper extremity of the head shows an unbroken line with the neck. The articular surface of the head which is orange-shaped and that of the acetabular cavity show no erosion. The right hip is perfectly normal.

Fig. 4. Case 2. A radiogram taken about a year later than Figure 3, showing an involvement of the right hip which was normal in the previous figure. The head is separated from the neck, displaced downwards and backwards. The neck forms an unbroken line with the head. The articular surfaces are perfectly normal.

when attempting to walk. The pain at first was slight but gradually became worse. Two weeks after the onset, pain developed in the opposite hip and thigh. The pain became progressively more severe; upon any attempt to move the thighs it became unbearable. When completely at rest there was no pain, but jarring the bed or changing the position of the patient caused a violent paroxysm of pain. The past history was negative.

Physical Examination.—Patient was an over-developed girl appearing older than her age. She did not complain of pain while at rest. Both limbs were in the position of adduction and external rotation. The muscles of the thighs were spastic and motion was restricted on account of pain. There was no marked atrophy present. The limbs, however, tended to evert at the hip joints.

X-ray Findings.—Right hip (Fig. 1). There seemed to be an absorption of a considerable portion of the neck of the femur, with separation of the head. The head was considerably larger than normal. Figure 2 shows condition of left hip.

Case 2.—Female, aged 11, stated that about a month before she had developed pain in the left knee joint. The pain caused her to limp. An X-ray examination was made of the knee joint and it was found negative.

Physical Examination.—Well-developed, obese girl, appearing older than her age. The first thing noted was an adduction of the thigh, with eversion of the foot. A slight amount of atrophy was present above the knee. The thigh appeared larger in circumference and this increase in size extended to the hip joint. There was shortening of an inch and a half of the left extremity. The thigh and inguinal region were tender to pressure but there was no sensitiveness. There was a limitation of the thigh to abduction, extreme flexion and internal rotation. There was pain in the hip joint when the extremities of motion were reached.

Fig. 5. Case 3. Shows atrophic changes in the head, with accentuation and widening of the epiphyseal line. There is no displacement present. The patient was treated for a beginning epiphyseal separation and we were successful in avoiding a separation.

Fig. 6. X-ray plate of the right knee joint of Case 3, showing epiphyseal widening in femur, tibia, and fibula. This patient is 18 years old and should have no epiphyseal widening.

X-ray examination revealed a widening of the epiphyseal line.

The limb was put in extreme abduction in plaster of Paris and after ten days a radiogram was taken and the following noted: "The left hip shows an increased widening of the epiphyseal line over what was noted at the previous examination. The neck of the femur is displaced upwards while the head is displaced downwards. There is also a diminution of the joint space. No destruction of the acetabulum or erosion of the head are present. The head of the femur has the characteristic appearance of an inverted comma, wider at the under surface and tapering upwards, forming a continuous line with the neck."

Subsequent History.—About eight months later the patient was brought to the office, because of pain in the right knee joint. The pain was similar in character to that of the opposite side. On physical examination it was noted that the thigh was adducted and slightly rotated externally. The muscles around the hip were somewhat spastic and there was tenderness around the hip joint, especially in the groin. The roentgenogram of both hip joints revealed the following: In the right hip there was a displacement of the neck downwards, similar to that noted on the opposite joint at the onset of trouble. In addition, there was a greater rotation of the neck anteriorly so that it appeared to overlap the head. Here, as in the left hip, the neck and head formed a continuous line except that at the uppermost junction there was present an area of rarefaction the size of a cherry pit. The

Fig. 7. Case 4. The original film, showing a complete separation, has been misplaced. Patient entered hospital with a complete spontaneous separation of the femoral neck. This was reduced. This figure shows a complete reduction. The head appears a little wider, the margins slightly overhanging the neck. The epiphyseal line is markedly accentuated and widened. The head of the femur shows areas of atrophy. The head is perfectly smooth at the articular surface and shows no erosions. The acetabular cavity is smooth but assumes a "citron shape" (according to Calot).

left joint at this time showed evidence of a coxa vara. The head and neck had united and the epiphyseal line was barely perceptible. The head remained in downward displacement and there was callus projecting downwards from the head below the lower surface of the acetabulum.

Case 3.—Boy, 18 years old, states that two months prior to the onset of trouble he fell down a flight of stairs, injuring his right knee. The pain in the knee kept getting worse and extended to the inguinal region. He experienced a burning sensation on the inner side of the thigh and knee and was confined to bed. Any motion of the thigh set up a paroxysm of severe pain.

Physical Examination.—Well-developed

Fig. 8. Case 5. Shows a deformity of the head and neck of the femur. There is no destruction of the head nor erosion of the acetabulum. The head is rotated downwards and forwards and forms an unbroken line with the neck. This case is an old healed epiphyseal separation in a patient 40 years of age, who received no treatment for the condition.

young man, over-weight. The limb was held in abduction, with eversion of the foot. There was no shortening. The right thigh was much larger than the opposite, with a prominence over the great trochanter. The muscles were spastic and there was a limitation of abduction and rotation of the thigh.

There was a rarefaction of the head and neck of the right femur. The head appeared larger than normal and the epiphyseal line was wide. The lower two-thirds of the joint space was obliterated, leaving the upper third of the joint space visible. At the lowermost margin of the joint surface there was an area of rarefaction. At the lower part of the head near what should be the joint surface, there was an area of rarefaction about the size of a cherry. There was no separation or displacement of the head from the neck. X-ray examination of the right knee showed marked widening of the epiphyseal line of all the bones participating in the formation of the knee joint, that is, tibia, fibula, and femur.

Case 4.—Patient, male, aged 17, stated that he stumbled and injured his left hip about two months before coming to the hospital. The disability was gradual and slow-

ly developing, resulting in a well-defined limp. There was also considerable pain after exertion. There had never been a total loss of function. About two days prior to patient's admission to the hospital he stated that his hip suddenly gave way under him. On examination, it was found that there was a complete separation of the head from the neck of the femur. He was given an anesthetic, and traction and extreme abduction and internal rotation of the leg was carried out. He was then put in a plaster spica. Figure 7 shows the position of the limb after reduction. He was kept in plaster for about three months, when passive and active motion were instituted.

Radiographic examination at this time showed marked rarefaction and atrophy of the head and neck of the femur. The joint space was not obliterated. The lower half of the epiphyseal line was indistinct, while the upper surface of the head and neck formed the characteristic continuous line. The rotation of the head backwards and downwards was still evident. The epiphyseal margin of the neck was regular and showed no distortion, appearing wider than normal.

Case 5.—Patient, female, aged 40, stated that she had had trouble with her right hip since childhood. There was never any complete disability nor incapacity. All she recalled was a gradual development of limp and some discomfort. On examination, it was found that motion was restricted to abduction, flexion, and rotation. The right lower extremity was about three inches shorter. The X-ray (Fig. 8) revealed no definite destructive process. The head was deformed. No erosion of the articular surface of the head was present. The acetabulum was normal in outline. There seemed to be a persistence of the epiphyseal line, with a rotation of the head downwards and inwards. This case was evidently a separation of the head which healed in malposition.

Case 6.—Mrs. B., aged 42, stated that she had had trouble with her hip for many years. She did not remember having had a fall or injury to the hip joint. She had limped for many years but had not had much acute pain. During the past few years pain had made it difficult to walk.

Physical Examination.—The right leg extended was about two inches shorter than the left. The limb was slightly adducted and externally rotated. Motion was restricted in abduction, internal and external rotation. There was no muscle spasm.

The roentgenogram revealed marked obliteration of the joint space, but no destruction of the head. The lower margin of the head appeared thicker and wider and impinged on the lower surface of the acetabulum. The upper surface of the head and neck formed an unbroken line. There was increased bone reaction at the upper part of the head and acetabulum. The femur was rotated anteriorly and adducted. The epiphyseal line was wide, regular at the lower half and irregular at the upper half.

COMMENTS

Spontaneous separation of the hip, or, as we propose to call it, epiphyseolysis, is due to a constitutional disturbance, perhaps of endocrine origin.

A slight injury to the hip with gradually developing disability should lead one to suspect the presence of this condition.

The outstanding physical finding is adduction and external rotation of the thigh.

The X-ray confirms the diagnosis of the condition.

Separation of the epiphysis of the hip may be associated with epiphysitis elsewhere, such as in the knee joint.

We believe that vertebral epiphysitis, infarction of the metatarsal head, Osgood's

disease, belong to the same group and probably have the same etiological factor in common.

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Biology of carcinoma.—Following the discussion of the present assumption of the effect of roentgen rays on carcinoma, the author emphasizes the necessity of administering a minimum dose to all malignant tumors. The history of a case of recurrent carcinoma of the breast illustrates his opinion. The so-called carcinoma dose of Seitz and Wintz seems to be a good average value. One must also consider the possibility of a stimulating effect of roentgen rays on carcinoma, inasmuch as no one has proved or disproved its existence. The use of one large field of entry rather than several small fields side by side is recommended in treating breast carcinoma. Correction of the dose must be carefully done when changing to a long target skin distance. Outside of the loss as given by the inverse square law, there is another factor, the additional biological dose, which can not be calculated. It is based on the practical experience that increasing the treatment time four times when doubling the distance is not sufficient to get the same degree of erythema in both cases. If small fields have to be chosen, it is better to place them closely together and cause an over-reaction by overlapping the edges rather than an under-dose.

E. A. Pohle, M.D.

Regarding the Radio-biology of Carcinoma. Hans Dehler. Strahlentherapie, 1927, XXV, 239.

POSSIBLE DEVELOPMENTAL DEFECTS FOLLOWING OVER-RADIATION OF THYMUS IN EARLY INFANCY[1]

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HYPERPLASIA of the thymus gland has been a subject that has caused a great deal of discussion among members of the medical profession during the past decade. Internists, pathologists, physiologists, and radiologists have attributed the many complex symptoms occurring in infants and young children to an enlarged thymus, but whether their claims are entirely justified still remains in doubt. It is known that the thymus gland can be large without causing symptoms and, also, that we can have the symptom complex of status lymphaticus in infants and young children without any enlargement of the thymus gland. It is known that the thymus gland is subject to constant variations in size during the normal development of the child up to the age of adolescence, and that these variations may take place as a result of some mental or physical injury or excitement, even though trivial. In other words, the thymus observed at postmortem is not the thymus observed during life, nor is the thymus that is studied at one period during the day the same as the one that might be studied at another period. It is unstable and its size and activity are influenced by many metabolic processes within the body and by many psychic processes from outside the body. Whether there is an internal secretion has not been definitely proven, although Sajous and others have established many facts which would tend to substantiate the theory of its importance in body growth, especially those processes concerned in the production of lymphoid cells, which have to do with the growth of nerve and bony tissue.

The results of Sajous' experiments may be briefly summarized as follows: "The function of the thymus is to supply, through the agency of the lymphocytes, the excess of phosphorus in organic combination which the body, particularly the osseous, nervous and genital systems, requires during its development and growth, that is, during infancy, childhood, and adolescence, or later, if necessary.

"We must not lose sight of the fact that besides being supported by the bulk of available evidence from various branches of biological science, this interpretation of the function of the thymus accounts for the many different rôles that have been ascribed to this organ.

"The accumulated data indicate plainly, both from the clinical and experimental aspects of the question, the specific symptoms or stigmata which indicate hypothemia: (1) Deficient development of the osseous system and deformities suggesting rickets or osteomalacia, due to deficient assimilation of calcium as a result of the deficiency of thymic nucleins which take part in the building up of calcium phosphate, producing thereby a deficiency in stature; (2) Deficient mental development entailing various grades of idiocy due to the insufficient production of thymic nucleins to supply the neurones of the central nervous system during its development; (3) A low relative lymphocyte count, owing to the inadequate formation of thymocytes."

In the light of these experimental facts, which up to the present time have not been refuted, it would appear possible that any agent which would produce atrophy of the thymus gland in infancy might be the cause of the failure of the normal physical and mental development of the individual. This is well exemplified in the Mongolian type of idiocy. Here the stigmata of deficient bone

[1]Read before the Roentgen Ray Society of Central Pennsylvania, April 22, 1927.

growth, so distinct in thymectomized animals, are very marked. Defective bone development is shown by the low average stature, the adult patient seldom exceeding four feet in height, due mainly to the fact that the long bones, particularly of the legs, are abnormally short. The skull, likewise, shows participation in the morbid process and is abnormally small, and, with the lack of thymic nucleins to supply the neurones of the central nervous system, normal mental development is prevented.

According to Heinecke, Aubertin, Bordet, Régaud and Crémieu, the roentgen ray has an intense effect upon the thymus, which manifests itself in a degeneration, especially of the lymphocytes, which may be followed later by a regeneration. Régaud and Crémieu have tested these results in young cats and found that, after a dose of 14 Holzknecht units, a reduction of the thymus was demonstrable on the second day, which on the fifth day reached 80 per cent and at the end of two weeks was over 90 per cent. This was due to a necrobiosis and absorption of the thymic lymph nodes. Regeneration began about the fifteenth day in the lymphocytes that had remained intact, and finally led, by a karyokinesis, to a complete restitution. The gland could be completely destroyed by one irradiation of 50 Holzknecht units. Cozzolino states that, owing to the pronounced susceptibility of the thymus to the roentgen rays, the dose for children should be relatively small. It is neither necessary nor indicated to cause complete atrophy of the thymus, a comparative reduction in volume being sufficient.

The treatment of enlarged thymus in infants by the roentgen ray was first started in this country by Lange, in 1911. Three years following the publication of his article, and after considerable practical experience in the treatment of these cases, his deductions were as follows: "Roentgen irradiation of the thymus produces artificial involution of the gland. X-ray therapy is the method of choice in cases of enlarged thymus in children, whether symptoms be mild or urgent. Urgent cases should receive oft repeated, massive doses. Recurrences due to regeneration in the gland are to be watched for and controlled by further treatment. Children whose physical or mental development is retarded should, if suspicion is directed toward the thymus, receive trial X-ray exposures, even though a positive diagnosis of enlarged thymus cannot be made. X-ray therapy as a precautionary measure or as a pre-operative treatment may enable children of the so-called lymphatic type to withstand intercurrent disease and anesthetics which might otherwise prove fatal. Urgent cases should be treated both anteriorly and posteriorly at the first treatment, using a 9½ inch spark gap, 5 milliamperes of current, 9 inch focal skin distance, 4 millimeters of aluminum filter, for 5 minutes."

From the above quotation we learn that the pioneers in radiotherapy of the thymus advised relatively large doses, persisted in over a comparatively long period, but in the light of the experimental facts produced, comparatively heavy X-ray dosage in infants will produce a hypothymic condition with complete destruction of the thymic function, with resulting retardation of physical and mental development.

In my own experience I wish to present the history of two cases which, following radiotherapy of the thymic areas according to the Lange technic, developed the symptoms of a hypothymic condition. I appreciate the fact that the condition in these cases may have been coincident with the treatment, and not in any way a sequela. Nevertheless, as pointed out in the preceding experimental data, one cannot ignore the possibility of complete atrophy of the thymus from over-radiation, resulting in a failure of mental and physical development.

Case 1.—Frances S., aged 7 months, was referred May 2, 1923, with symptoms of attacks of cyanosis and difficult respiration. The child was very poorly nourished but otherwise features were normal. Radiograms showed uniform enlargement in the thymic area, fusing with the heart shadow, and diagnosed as a possible enlarged thymus. This was treated according to the Lange formula for dosage, over both anterior and posterior surfaces on successive days. Patient was much relieved, was returned on May 23 and given one similar treatment over the anterior area and one over the posterior area the following day. The child was returned on June 14, approximately six weeks following the first treatment. At this time the mother stated that the patient was 100 per cent improved and had had no attacks since the last treatment, was eating and gaining in weight. Treatment was again given over the anterior and posterior surfaces. Nothing further was heard until October of the same year, when the mother reported that the child was not doing well, although there had been no cyanotic attacks. The child was again treated anteriorly and posteriorly, as before. Nothing further was heard from the patient for about one year, when examination revealed the physical and mental features of a Mongolian type of idiocy. The child lived to be 2½ years of age, dying from a bronchial pneumonia following a digestive disturbance. She never became able to walk or talk nor did she show any intelligence.

Case 2.—Alexander M., aged 4 months, was referred for examination in November, 1923, with symptoms of attacks of cyanosis and difficult respiration. Radiograms showed an enlarged area of density in the thymus area, fusing with the heart shadow, diagnosed as a possible enlarged thymus. The child was well developed and looked healthy. Treatment was given according to the Lange formula, one anterior and one posterior on two successive days. The attending physician reported that the patient was entirely relieved of cyanotic attacks, and the child was not returned for further treatment. One year after the application of X-ray, the family physician reported that the child was healthy and doing well. Two years following the application of treatment, the physician and mother reported that the child was unable to walk or talk and the physician stated that the patient was beginning to assume the facial features of a Mongolian idiot. The last report of this patient was in 1926, three years after treatment, and was to the effect that he was becoming more and more of the Mongolian type.

With the possibility that these stigmata might have resulted from too heavy radiation of the thymic area, the dosage within the past year has been reduced to the following formula: 7 inch spark gap, 5 milliamperes, 15 inches target skin distance, 1 millimeter of aluminum, for 2 minutes, and only sufficient treatment given to relieve the symptoms, using one area at a time. In other words, if one such treatment of a single area relieved the symptoms of cyanosis and difficult respiration, no further treatment was given, and with this dosage and method of treatment the relief of symptoms has been equally as good as with the heavier radiation.

I fully realize that two isolated cases among the many thousands that have been treated offer little to support the theory that heavy radiation may produce a hypothymic condition. However, I do not believe anyone is justified in treating these cases except with small doses, repeated only when necessary to relieve symptoms and not with the idea of reducing the size of the thymic shadow upon the radiogram.

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Lung tumors.—Lung tumors are usually carcinomata of bronchi, or sarcomata, and it may be difficult to differentiate them from pleural tumors that have invaded the lung. The differentiation of lung tumors from mediastinal tumors is difficult, and tuberculosis of the hilus area may give a similar clinical picture. The clinical signs of lung carcinoma are those of a slowly infiltrating process extending into the lungs. Irritating cough and bloody expectoration occur early. Blood may be absent. A history of progressive loss of weight, pain in the chest, cough, bloody sputum, and absence of fever in a patient past forty, who is negative for pulmonary tuberculosis, is suspicious of a malignancy of the lung. The chest should be carefully examined in all cases of breast carcinoma for evidence of lung metastasis. If the lungs are involved, the patient is saved the torture of a radical breast operation. Lung tumors may cause elevation of temperature. In late stages pleural effusion occurs, usually hemorrhagic, and signs of compression appear, local edema of one side of neck and face, or of the arm.

A patient previously in good health begins to cough, at first non-productive, later mucoid, muco-purulent and bloody sputum. Dyspnea develops, chest pain, usually constant, which may be referred to axilla, sternum, shoulder or abdomen. Compression of esophagus and trachea, or recurrent laryngeal nerve may cause dysphagia and hoarseness. Physical signs depend on size and location of the tumor. Primary lung tumors are usually situated in the upper portion of the lung, while metastatic tumors are found in lower portions. Roentgenographic examination of the chest is a most valuable aid to diagnosis. The X-ray will reveal lung pathology prior to appearance of physical findings.

CONCLUSIONS

"1. A history of progressive loss of weight, pain in chest, cough, bloody expectoration, and absence of fever, in a patient past forty, who has had no history of pulmonary tuberculosis, is very suspicious of malignancy of the lung.

"2. All patients with carcinoma of the breast should have a thorough examination of the chest for evidence of lung metastases before a radical amputation of the breast is performed.

"3. Unilateral bronchostenosis indicates carcinoma of a bronchus.

"4. Rapidly recurring pleural effusion, even if not hemorrhagic, is suspicious of malignancy.

"5. Lung tumors at times cause an elevation of temperature.

"6. Bloody pleural fluid suggests malignancy.

"7. The various diagnostic procedures such as (1) examination of sputum for tumor cells; (2) bronchoscopic and diagnostic pneumothorax; (3) roentgenograms (stereo-), and (4) thoracoscopic examination should be carried out."

C. H. DEWITT, M.D.

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CASE REPORTS

REPORT OF A CASE OF THYMOMA[1]

By MAURICE F. DWYER, M.D.,
Virginia Mason Hospital, SEATTLE, WASHINGTON

Primary tumors of the thymus are rare. Thymoma or lymphosarcoma is the most frequent and in all probability no neoplasm is so susceptible to radiation. The response is so dramatic that radiation should be always employed in the differential diagnosis of tumors of doubtful nature.

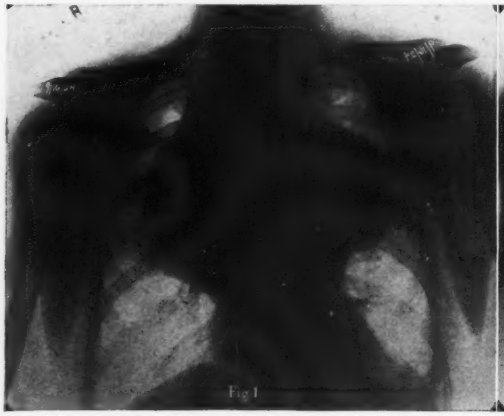

Fig. 1. Roentgenogram showing extent of tumor, September 16, 1924.

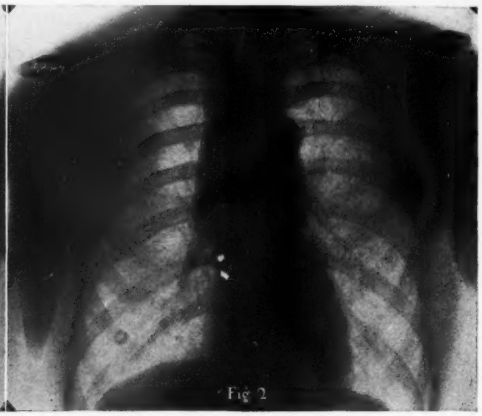

Fig. 2. Roentgenogram showing marked reduction in size of tumor shadow, October 21, 1924, one month after first course of roentgenotherapy.

CASE HISTORY

Mr. A. T. (Case No. A-16,643), age 42, came to the clinic September 19, 1924, complaining of "heart trouble." A few days prior to that date he had received in another city a diagnosis of thoracic aneurysm. The family history and past history were unimportant.

He felt perfectly well until September, 1923, at which time he began to be troubled with "a cold on the chest" which recurred at frequent intervals for approximately six months. In April, 1924, he noticed that he tired easily, and there was a slight loss of weight. Two months later he noticed dyspnea on slight exertion. This was accompanied by wheezing and a feeling of oppression in the chest and by precordial pain radiating down the left arm. In August, 1924, one month before consulting us, he became extremely nervous and the left arm felt numb. He had frequent attacks of vertigo and headache, was able to sleep only in an upright position, and was greatly distressed when lying down.

Physical examination revealed many prominent veins over the upper thorax. There was moderate cyanosis. The pupils were equal and reaction was normal. There was marked increase of mediastinal dullness. Bronchial breathing was present in the upper half of the left chest posteriorly. There were no palpable glands. Wassermann reaction on the blood was negative. Complete blood count and urinalysis were normal. Roentgen-ray examination of the chest September 16, 1924 (Fig. 1), showed a large non-pulsating flattened mass in the mediastinum. A diagnosis of mediastinal tumor, probably lymphosarcoma, was made and roentgen-ray therapy advised.

The first series of treatments was begun

[1]From the Mason Clinic.

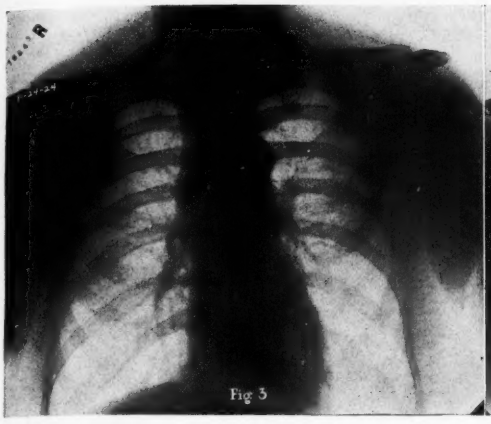

Fig. 3. Roentgen-ray appearance on November 24, 1924, one month after second course of roentgen-otherapy.

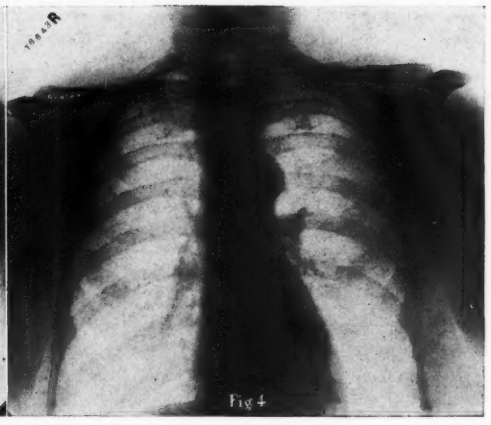

Fig. 4. March 6, 1925. Only very slight roentgen evidence of mass remains.

September 21, 1924. Six hundred milliampere minutes at 145,000 volts, 16 inch distance with 0.25 mm. copper on 1 mm. aluminum filtration was administered in the course of four successive days. Half of this dose was given through the front of the chest and half through the back. The patient was requested to return in a month for re-examination.

He returned October 21, 1924, one month from the beginning of his first course of treatments, and stated that he "felt like a new man." The precordial pain, fullness in the chest, numbness in the left arm, dyspnea, wheezing and cough, had completely disappeared. He was able to lie in bed and sleep all night. The enlarged thoracic veins formerly present were no longer visible. A roentgenogram of his chest taken on October 21, 1924 (Fig. 2), showed that in one month the tumor had been reduced to approximately one-sixth of its original size. A second series of roentgen-ray treatments was then given, using the same factors. He

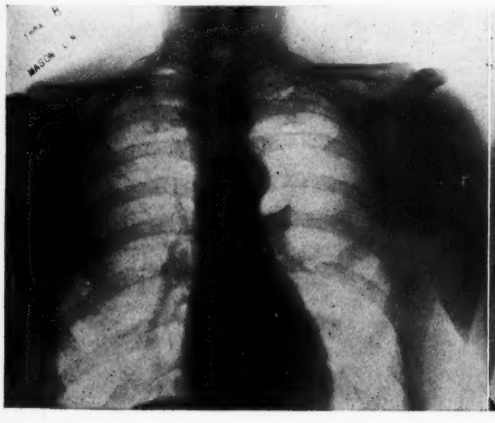

Fig. 5. August 5, 1925. No evidence of tumor.

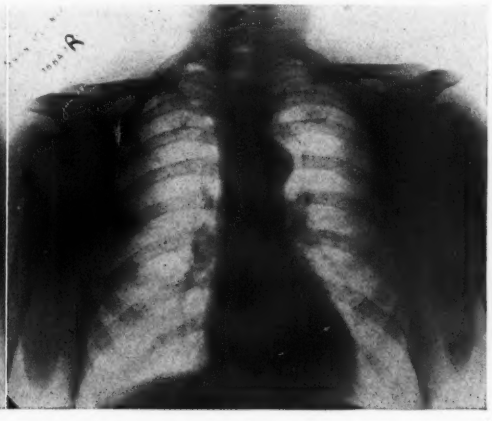

Fig. 6. January 19, 1927. No roentgen evidence of tumor, twenty-eight months from time of first course of roentgen-ray treatments.

returned November 24, 1924. Roentgen examination of his chest (Fig. 3) showed a slight reduction in the size of the growth as compared with the finding (Fig. 2) made one month previous. A third series of treatments was then given. The patient again returned March 6, 1925, and stated that he was free from all former symptoms and had gained two pounds. A roentgenogram of his chest (Fig. 4) made on this date showed only very slight evidence of the tumor. Observation on August 5, 1925 (Fig. 5), revealed no evidence of the original tumor.

He was again seen on January 19, 1927. He stated that he was feeling fine and a roentgenogram of the chest was negative.

He was last seen in September, 1927, three years after his first course of treatments, and no clinical or X-ray evidence of the disease could be found.

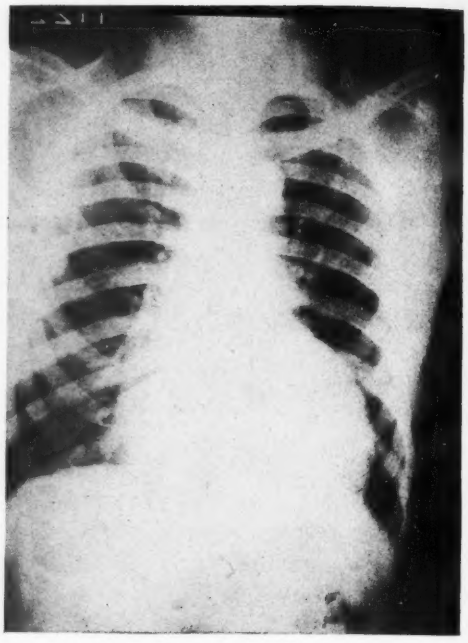

Fig. 1. Teleoroentgenogram made February 26, 1926, showing enlarged left ventricle and dilated aorta.

THORACIC ANEURYSM: REPORT OF CASE

By ROBERT C. PENDERGRASS, M.D., and JAMES J. CLARK, M.D.

From the Department of Roentgenology, Emory University School of Medicine, ATLANTA, GEORGIA

This case is reported for the following reasons:

1. The aneurysm is an unusually large one.

2. An opportunity is given to observe the progressive increase in size which an aneurysm may undergo in one year.

3. The destructive force of a pulsating, blood-filled aneurysmal sac is well illustrated.

Case No. 23,545, Emory University Division, Grady Hospital, Atlanta, Georgia. H. T., colored laborer; age 37; chief complaint, "knot in left side; pain through the heart." Admitted February 14, 1927. *Family history,* negative. *Marital history,* married twice. (First wife died with miscarriage; no children by second wife.) *Past history,* negative. *Present illness:* Onset in January, 1926, with dyspnea, and pain in left chest and back. Most severe over precardium and in left axilla. Admitted to Medical Clinic, Out-patient Department, on February 23, 1926, complaining of pain in left side, over lower sternum and axilla. Physical examination showed a heart hypertrophy to the left and downward.

On February 26, 1926, fluoroscopic and teleoroentgenographic examination (No. 1,220) showed left ventricular hypertrophy; dilatation of upper portion of descending aorta, without the visualization of a distinct aneurysmal sac. A slight bulging of the descending aorta into the posterior mediastinum was noted. Due to the presence of almost constant thoracic pain, and the dilatation of the aorta, the diagnosis of probable early aneurysm of the descending thoracic aorta was made at this time.

March 1, 1926, blood Wassermann was reported four plus. Patient was referred

to Syphilitic Clinic for treatment, but there is no record of his having received such treatment.

Patient resumed his occupation as a shoe packer, and continued same until September, 1926, when the pain in left chest became more severe, and he noticed the appearance of a small mass about the size of a hen's egg on the left posterior chest wall, about one hand's breadth from the spine and at the level of the ninth rib. The pain grew progressively more severe, the mass gradually increased in size, and the patient became unable to lie on the left side.

He did not return to the Clinic until December, 1926, at which time rest in bed was prescribed, and he was told to return January 4, 1927, when the tumor mass was found to measure 10×6 cm., and was pulsating forcibly. A diagnosis of thoracic aneurysm was made.

On February 13, 1927, the patient experienced a sudden sharp pain on the left side, in the region of the mass, and said he "felt like something bursted inside." On February 14 he was admitted to the Medical Ward of the hospital, with a chief complaint of "knot on left side, and pain through the heart."

Physical examination showed painful facies; slight clubbing of nails, anemia of mucous membranes, and evident dyspnea, with limited movement of the left chest wall. The right heart border was about 6 cm. from the midsternal line in the fourth interspace. The left heart border was continuous with an area of flatness extending anteriorly from the fourth rib to base of lung, and extending into a tumor mass in the posterior axillary line. Heart sounds were faintly heard over the flatness in the left axilla.

The first sound of the heart was distinct, and was followed by a systolic blow. Second sound at base was clear. There was only slight accentuation of the aortic second sound. Breath sounds of the left lung were suppressed. Right lung appeared normal.

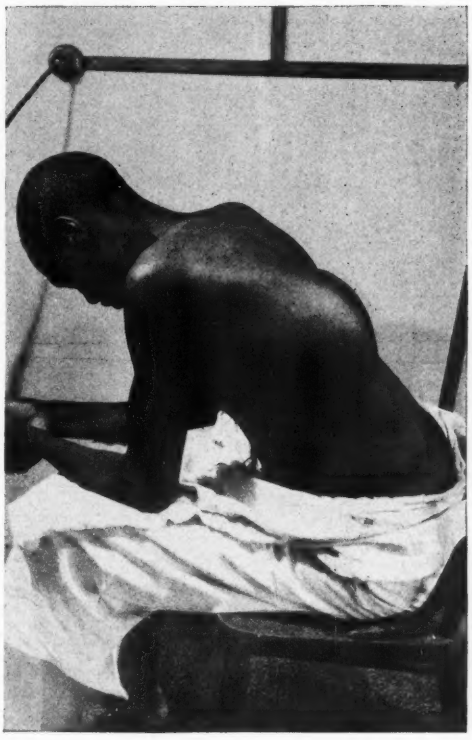

Fig. 2. Showing aneurysmal sac on left posterior chest wall (February 14, 1927).

On the left posterior chest wall was noted a tumor mass extending from the fourth to the twelfth ribs, about 20×24 cm., pulsating forcibly and expansively, pulsations being synchronous with the heart beat. The skin over the tumor mass was smooth and glistening, and was fairly loosely attached except over the apex of the mass. There was a very distinct bruit over a small area. A fluid wave was noted on percussion. The eighth, ninth, and tenth ribs could not be palpated over the greatest prominence of the mass.

Vital capacity 50 per cent of normal; blood Wassermann four plus; urine, negative; red blood cells, 3,670,000; hemoglobin, 65 to 70 per cent; white blood cells,

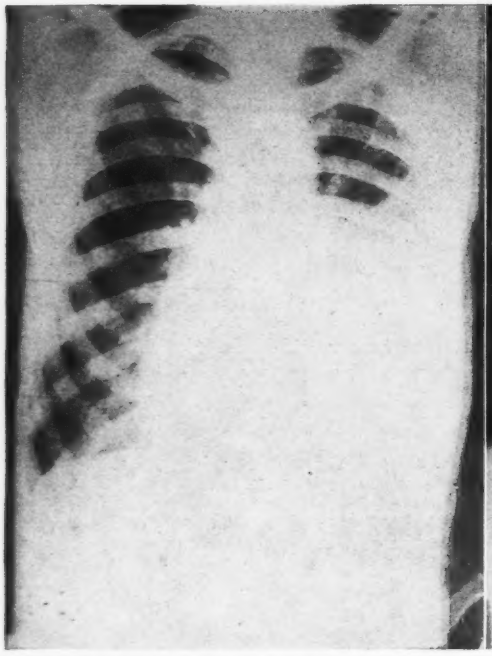

Fig. 3. Teleoroentgenogram made February 14, 1927, approximately one year after first examination. Aneurysmal mass filling lower left chest. Compare with Figure 1.

Fig. 4. Oblique radiograph showing destruction of ribs.

5,150; blood chemistry normal. Practically no difference in blood pressure of the two arms—right arm, 60/40; left arm, 60/38. Ophthalmoscopic examination showed arteriosclerosis and neuroretinitis, O.D. and O.S.

Fluoroscopic and film examination showed an area of uniform density in the left chest, extending from the fourth rib anteriorly to the lung base. The upper border of this area could not be seen to pulsate forcibly, although pulsation was clearly visible over the posterior surface on lateral examination. The right cardiac border was slightly farther beyond the midline than normal. The aortic arch and upper portion of the descending aorta showed a moderate dilatation, only slightly increased over that noted on previous examinations (Fig. 3).

The posterior mediastinum was obscured by the large shadow above noted.

Lateral film examination showed destruction of parts of the seventh, eighth, ninth, and tenth ribs, left posteriorly (Fig. 4).

The possibilities of thoracic aneurysm, abdominal aneurysm, and thoracic tumor were considered in the order named. In order to differentiate between thoracic aneurysm and abdominal aneurysm, which might have pushed up the left diaphragm, thus producing the non-pulsating upper border of the dense area, a barium meal was given. The esophagus appeared normal, and the stomach and diaphragm were found to be in their normal relation and position, thus confirming the first diagnosis of aneurysm of the descending portion of the thoracic aorta.

The patient voluntarily left the hospital on March 2, 1927.

Observation on May 14, 1927, showed marked increase in pain, dyspnea, and in the size of the mass. The entire left chest was

dull from the base to the apex. The ninth and tenth left ribs were loose, the patient complaining that they "floated about and stuck him in the side." The mass on the left back measured 30 × 35 cm. The skin over the mass showed excoriation. There was generalized edema, with preponderance of the edema on the left side of the face and in left leg and foot. Abdominal ascites, with demonstrable fluid wave, was also present. Patient was forced to sit up in order to breathe. Observation was made in the home, and no photographs or roentgenograms were obtained.

The patient died suddenly on May 23, 1927, from external rupture of the aneurysm.

DIVERTICULUM OF SECOND PORTION OF DUODENUM

CASE REPORT

By. A. CASSAR, M.D., ALEXANDRIA, EGYPT

The patient, Mrs. X., 37 years of age, was referred for gall-bladder examination. Three years previous to this time, she had experienced an acute pain in the right upper quadrant, which was scarcely relieved by morphia. Following that attack, she was in good health for over two years, until June, 1926, when the pain recurred at intervals of two or three weeks. It was, however, not so acute as at the previous attack.

Iodeikon was administered twice, but the gall bladder was not visualized either time. The patient was then given a barium meal, whereupon a pouch was seen in the external part of the second portion of the duodenum, surmounted by a gas bubble which showed peristaltic waves on its lower contour. The diagnosis considered three possibilities: (1) probable gall-bladder disease; (2) adhesions; (3) diverticulum.

Fig. 1, showing a diverticulum in the external part of the second portion of the duodenum.

Upon operation, about thirty stones were found in the gall bladder, the largest of which was impacted in the cystic duct. There were so many adhesions and the dissection of the gall bladder proved to be so extensive a process that the surgeon thought it imprudent to prolong the operation by extending it to the diverticulum, although he saw a prolongation of the duodenum which he judged to be due to the latter.

EDITORIAL

M. J. Hubeny, M.D. . . . . *Editor*
Benjamin H. Orndoff, M.D. *Associate Editors*
John D. Camp, M.D.

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THE RADIOLOGIST AND HIS APPARATUS

The relation existing between radiologists and the manufacturers of radium applicators, deep therapy apparatus, tubes, films, and the host of agents through the instrumentality of which a radiologist makes his examinations or administers his treatments, is a peculiarly close one. In the branch of medicine represented by members of this Society, there can be no sharp line drawn between those who devise and those who use. Physicians approach the problems of the diagnosis and treatment of disease from one side, the manufacturers of apparatus whereby radiant energy is made available for their purposes from another, and the physicists work toward solution from all sides—dosage, uniform units of measure, biological effects, and protection.

Since we are all making common cause toward one goal—the solving of physical problems—we have found it of material advantage to meet together and present both scientific and commercial exhibits. Physicians cannot launch impractical ideas but must use such instrumentalities as have been created for the achievement of their aims. Some of the most valuable ideas in the application of the science of radiology have come from the men who, as artisans, have determined what adaptations can be made of the materials at hand. The physician *per se* is seldom an inventive genius.

At the annual meetings one draws no line between user and maker—both contribute to the advancement of science in this particular realm. In no sense does such a mingling render physicians commercial, nor obscure the true issue to the manufacturers. Each group can learn from the other, and each exhibit but binds the tie the stronger.

NEW ORLEANS

The city of New Orleans occupies a unique position among the large cities of the United States, because besides being over two hundred years old, one of the oldest social, medical and literary centers, the metropolis of the South, progressive and up to date, it still retains, due to the French and Spanish influence resulting from nearly a hundred years of occupancy, that subtle charm found in the cities of southern France and Spain. This charm is felt by all those who make it their home, and during your only too brief stay amongst us you will see many material evidences of it in the Vieux Carre (Old French Town).

But let me tell you about New Orleans, past and present, in the words of some of the distinguished writers who have visited it, not only because their word-pictures are better than mine could ever be, but in order to spare the modesty of a native son.

In the later 1840's Oakey Hall, who subsequently became Mayor of New York, speaking of the first St. Charles Hotel, completed early in 1837, and since destroyed by fire, exclaimed, "Set the St. Charles in St. Petersburg and you would think it a

palace; in Boston (ten to one) you would christen it a college; in London and it would marvelously remind you of an exchange; in New Orleans it is all three." Lady Wortly, an English woman who had travelled about the globe, and who wrote her "impressions of America," has left on record her verdict that "the St. Charles was the finest piece of architecture she had seen in any place in the New World." It must be remembered that this was before the United States became the hotel building and the hotel dwelling nation that it subsequently became. At that time there was no Commodore, no Blackstone, nor even a Palmer House or Pacific Hotel.

The following article, written by an anonymous author in *Harper's Weekly* of Sept. 3, 1859, furnishes an excellent penpicture of the Charity Hospital, built in 1832, after the earlier buildings—the first of these erected in 1737 — had been destroyed by fire.

"The New Orleans Charity Hospital is one of the most celebrated institutions of its kind in the United States. Not only so, but in the liberality of its support, the commodiousness of its buildings, the systematic excellency of its curative arrangements, the number of its beneficiaries, the superior skill of its attending physicians, the admirable neatness of its domestic appliances, and the impartial catholicity of its administration, it will compare favorably with the older and more renowned establishments of England and the Continent.

"Nor is it amiss to say that, whether regard be had to the ability of the Professors or to the admirable advantages offered to the pupil, there is no better place in the country than New Orleans for young men who are studying to enter the medical profession."

Frederick Lewis, in the October, 1927, number of the *Woman's Home Companion,* in an article on New Orleans says, amongst other things, "New Orleans possesses many romantic figures of the near and distant past around whose names have gathered the anecdotes and legends which constitute the peculiar charm of the city's history. Many of them have likewise left their marks on the stones and mortar of the city's present-day structures; especially in the Vieux Carre, the old French quarter, where the balconied buildings which line the narrow streets recall the grandeur of other times. Here is the New Orleans that we read about in the guidebooks and the railway folders; the New Orleans which styles itself 'The Paris of America'—the city of restaurants and cafés.

"When it comes to New Orleans cooking I could write a book (and eat a library!), but I shall content myself with saying what I have said so many times before—in print and in person to the lovers of good food: Go to Antoine's in the French quarter. Make no resistance when the waiter brings you a tin of villainous looking baked oysters. They are a specialty of the house and remarkably good.

"Go to La Louisiane. Order pompano papillote or bouillabaisse. Go to Galatoire's. Go to a dozen other little restaurants in the back streets of the Vieux Carre. You can't get a bad meal. You may find waiting for you in the unlikeliest of places the choicest banquet of your epicurean life. Or go to Begue's, where you begin to eat at eleven in the morning and keep on eating until three in the afternoon.

"I can imagine that regular attendance at Begue's might prove fatal. But there are worse deaths. And New Orleans remains interesting—even in matters of interment! The places where the famous figures of New Orleans history lived during their brief period on earth are not more picturesque than the places where their ashes have lain during their long rest in the city's famous cemeteries. The old St. Louis Cemetery where

the unique practice of burying above ground was first instituted is now closed except for the occasional admission of some long-lived and almost forgotten figure out of the city's past; but the larger and even more picturesque Metairie Cemetery is still the most ornately picturesque of New Orleans' burial grounds.

"New Orleans is not behind the times. But she is content to add a few modern improvements; she isn't willing to substitute them for ancient charms. She builds beside but not on her early glories. She still retains the brightest jewels of her crown."

So come to New Orleans for the meeting of the Radiological Society. You are assured a warm welcome, a splendid scientific program, and, if the weather is true to form, a mean temperature of fifty degrees, lots of sunshine, and all the vegetation green.

AMEDEE GRANGER, M.D.

THIRTEENTH ANNUAL SESSION

THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

NEW ORLEANS, LOUISIANA

NOVEMBER 28 to DECEMBER 2, 1927

Meetings to be held in

HOTEL ROOSEVELT, NEW ORLEANS, LOUISIANA

AN INVITATION

All members and friends of The Radiological Society of North America are cordially invited to attend the Thirteenth Annual Session. The program which has been prepared will be scientific and clinical in character. The list of contributors both from home and abroad guarantees that the best which radiology has to offer will be presented at this meeting. The Program Committee has kept in mind the needs of *all those who are practising radiology, internal medicine, surgery and other specialties, as well as those who are in general practice and the allied sciences.* You are cordially invited to attend.

EDWARD W. ROWE, M.D., *President.*

ANNOUNCEMENTS

TRAVEL NOTES

Nearly all who attend the coming meeting at New Orleans will stay over in the South and take in some of the side trips. Because of the prevalence of the regular winter tourist rates, it was deemed inadvisable to apply for the usual convention rates. The winter tourist rates are in effect from nearly all over the United States and Canada from October 15 to May 31, while the convention rates permit of only a *short stay after the meeting and no stop-overs en route.*

A splendid opportunity to visit Cuba, Honduras, and the Panama Canal, in the company of friends and acquaintances, is offered in the United Fruit Company's cruise on the S. S. *Parismina,* which sails from New Orleans Saturday, December 3, at 11 A. M., returning to New Orleans on the 19th. Some desirable accommodations are still vacant. A few who do not care to make the entire trip, but would like to go to Havana and return only, may be accommodated. A splendid time is promised in Havana, where the local radiologists and physicians are making elaborate arrangements for our entertainment. Write or wire me immediately if you desire to join this cruise for the entire trip or only to Havana and return. *This is the only steamship cruise that I am sponsoring.*

Those attending the meeting who will travel *via* Chicago or other points along the Illinois Central are invited to travel in our Special. We will have a special train if enough apply and special coaches on the

regular trains otherwise. I will be glad to make reservations for all who write or wire me. *Be sure you buy Winter Tourist round-trip ticket to New Orleans and return.*

See RADIOLOGY, July, 1927, p. 80, and November, 1927, p. 436, for previous announcements.

COMMERCIAL EXHIBIT

The Commercial Exhibit promises to be up to the usual high standard of previous meetings. Exhibitors displayed such great interest in this meeting that *all the space was sold during the first five days* it was put on the market. This breaks all previous records, and shows us that the manufacturers and dealers appreciate our efforts, and benefit by being with us year after year.

A good exhibit of apparatus and accessories has high educational value and all who attend this meeting should make it a point to visit every exhibitor and see all that is new and valuable about each particular line. It pays to keep up to date on apparatus as well as on technic and other things. These exhibitors practically pay the expense of our meetings, and they deserve high commendation for staying with us year after year. Several firms have exhibited at every meeting that this Society has had, and I take this opportunity to thank them, *for the Society,* for their continued aid and interest.

I. S. TROSTLER, M.D.
Manager of Commercial Exhibit,
812 Marshall Field Annex,
Chicago, Illinois.

PROGRAM COMMITTEE

ROBERT A. ARENS, M.D.....Chicago, Ill.
W. W. BELDEN, M.D.....New York City
W.E. CHAMBERLAIN, M.D...San Francisco, Cal.
A. U. DESJARDINS, M.D.....Rochester, Minn.
GEORGE W. GRIER, M.D.....Pittsburgh, Pa.
LEON J. MENVILLE, M.D.....New Orleans, La.
JOHN W. PIERSON, M.D.....Baltimore, Md.
DOUGLAS QUICK, M.D.....New York City
LE ROY SANTE, M.D.....St. Louis, Mo.
M. C. SOSMAN, M.D.....Boston, Mass.

ADVISORY PROGRAM COMMITTEE

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I. SETH HIRSCH, M.D.....New York City
LEON T. LEWALD, M.D.....New York City
BENJAMIN H. ORNDOFF, M.D.....Chicago, Ill.

COMMITTEE ON SCIENTIFIC AWARDS

B. H. NICHOLS, M.D., *Chairman*.....
.....Cleveland, Ohio
B. R. KIRKLIN, M.D.....Rochester, Minn.
MAX KAHN, M.D.....Baltimore, Md.

LOCAL COMMITTEES

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LEON J. MENVILLE, M.D., *Chairman*
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Hotels and Registrations
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Ladies' Entertainment Committee

Mrs. Amedee Granger, *Chairman*
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Mrs. Clyde Lynch
Mrs. L. J. Menville
Mrs. John H. Musser
Mrs. Mozart Rainold
Mrs. E. C. Samuel
Mrs. John Smyth

Program for New Orleans Night

P. L. Thibaut, M.D., *Chairman*
F. J. Chalaron, M.D.
T. J. Dimitry, M.D.
W. C. Hava, D.D.S.
A. C. Meynier, D.D.S.
S. L. Tiblier, D.D.S.

LADIES' SOCIAL CALENDAR

Tuesday, November, 29, 10:30 a. m.

Sightseeing tour through the Vieux Carre. Tours start from the lobby of the Hotel Roosevelt.

Wednesday, November 30, 12:30 p. m.

Luncheon—Bridge — Country Club

8:00 p. m.

Open Meeting — Hotel Roosevelt

Thursday, December 1, 1 p. m.

Luncheon — Patio Royal

Followed by informal shopping tour in the Antique Shops

7:00 p. m.

Annual Banquet and Dance — Hotel Roosevelt

Friday, December 3, 2 p. m.

Bus ride through the city.

The assembly place for all the morning and afternoon functions will be the lobby of the Hotel Roosevelt near the University Place entrance.

PROGRAM

MONDAY, NOVEMBER 28

8:30 a. m.—12 Noon

Arrival
Registration
Opening of Scientific and Commercial Exhibits
Secure tickets for Clinics and Banquet, and arrange for visit to Leper Colony.

MONDAY, NOVEMBER 28

Afternoon Session, 1 P. M.

Opening Meeting

Call to Order.....Dr. Edward W. Rowe
President, Radiological Society of North America.
Invocation .....Rev. F. D. Sullivan, S.J.
President of Loyola University
Presentation of Key to the City.....
.....Hon. Arthur J. O'Keefe
Mayor of New Orleans
Welcome on Behalf of the Local Profession.....Dr. A. E. Fossier
President, Orleans Parish Medical Society
Response.....Dr. Edward W. Rowe
President, Radiological Society of North America

Scientific Session

Prof. Herman Holthusen, M.D. (30 minutes), Hamburg, Germany
"The Present Status of Dosage Measurements."

Symposium on Practical Dosimetry

Leader, Arthur W. Erskine, M.D., Cedar Rapids, Iowa
E. A. Pohle, M.D., and
J. M. Barnes, M.D., Ann Arbor, Michigan
"Practical Dosimetry."
Otto Glasser, Ph.D., Cleveland, Ohio
"Physical Factors that Govern Radiation Dose."
W. Edward Chamberlain, M.D., and
Robert R. Newell, M.D., San Francisco, California
"The Epilation Dose: A Comparison of Filtered and Unfiltered Roentgen Ray."

MONDAY, NOVEMBER 28

Evening Session, 6:30 P. M.

COUNSELORS' DINNER, "DUTCH."
All members invited.
Executive session following.

TUESDAY, NOVEMBER 29

Morning Session, 9 A. M.

SECTION "A"

Leader, A. U. DESJARDINS, M.D., Rochester, Minnesota

JOHN F. HERRICK, M.D., Ottumwa, Iowa
"Treatment Records."

LEWIS JAMES CARTER, M.D., Brandon, Manitoba, Canada
"Analgesic Properties of the X-ray."

PROF. FRANZ M. GROEDEL, M.D. (30 minutes), Bad-Nauheim, Germany
"The Physical Treatment of the Diseases of the Circulatory Apparatus."

HARRY LAURENS, PH.D., New Orleans, Louisiana
"The Effects of Carbon Arc Radiation on the Blood and Circulatory System."

F. B. GRANGER, M.D., Boston, Massachusetts
"The Advantages of Combining Methods of Treatment in Physical Therapy."

RALPH PEMBERTON, M.D., Philadelphia
"The Nature and Treatment of Arthritis, with Consideration of the Rationale Underlying Some Forms of Physiotherapy Useful in this Disease."

HORACE LO GRASSO, M.D., Perrysburg, N. Y.
Subject to be announced.

A. U. DESJARDINS, M.D., Rochester, Minn.
"Radiotherapy in Actinomycosis and Blastomycosis."

TUESDAY, NOVEMBER 29

Morning Session, 9 A. M.

SECTION "B"

H. J. ULLMANN, M.D., and
M. J. GEYMAN, M.D., Santa Barbara, Calif.
"Osteochondritis Dissecans."

PAUL F. TITTERINGTON, M.D., St. Louis, Missouri
"Fractures of the Bones of the Face."

I. SETH HIRSCH, M.D., New York City
"Generalized Osteitis Fibrosa."

W. W. BELDEN, M.D., New York City
"Paget's Disease, Osteitis Fibrosa and Closely Allied Bone Diseases."

W. R. BETHEA, M.D., Memphis, Tennessee
"Intracranial Study by Ventriculogram."

RALPH HOPKINS, M.D., New Orleans, La.
"Roentgen-ray Demonstration of Bone Lesions in Leprosy."

JOHN T. MURPHY, M.D., Toledo, Ohio
"Calcifications of the Skull, Brain, etc."

RALPH E. HERENDEEN, M.D., New York City
"X-ray Treatment of Bone Tumors."

MAX KAHN, M.D., Baltimore, Maryland
"X-ray Treatment of Bone Tumors, with Special Reference to Tumors of Unconfirmed Diagnosis."

TUESDAY, NOVEMBER 29

Afternoon Session, 1 P. M.

BUSINESS SESSION, 1 P. M.

SCIENTIFIC SESSION, 1:30 P. M.

Symposium on Cancer

Leader, ROLLIN H. STEVENS, M.D., Detroit, Michigan

FRANCIS CARTER WOOD, M.D., New York City
"Biology of Cancer."

L. C. KNOX, M.D., New York City
"Radiosensitiveness and Tissue Morphology."

WILLIAM CARPENTER MACCARTY, M.D., Rochester, Minnesota
"The Cancer Cell in the Practice of Medicine."

MAURICE J. GELPI, M.D., New Orleans, La.
"Review of Various Methods of Treatment of Carcinoma of the Cervix: Attendant Primary Mortality and Five- or Seven-year Cures."

ANTON LACASSAGNE, M.D. (30 minutes) Paris, France
"Importance of the Filtration and the Superior Satisfaction of the Employment of Pure Gamma Rays in the Radiotherapy of Cancer."

WILLIAM H. HARRIS, M.D., New Orleans, Louisiana
"Changes Produced in the Epithelial Arrangement of the Mammary Gland of Animals by Inversion of the Nipple."

EDWIN C. ERNST, M.D.,
M. T. BURROWS, M.D., and
L. H. JORSTAD, M.D., St. Louis, Missouri
"The Chemical and Biological Changes Induced by X-rays in Body Tissues."

TUESDAY, NOVEMBER 29

Evening Session, 8 P. M.

"NEW ORLEANS NIGHT"

Presiding: AMEDEE GRANGER, M.D., *First Vice-president*

C. EDMUND KELLS, D.D.S.
"The Oral Roentgenographic Diagnosis."

VAL. FUCHS, M.D.
"Value of Roentgenology in Oto-laryngological Diagnosis."

H. W. E. WALTHER, M.D.
"Achievements of Radiology in the Urological Field."

WEDNESDAY, NOVEMBER 30
Morning Session, 9 A. M.

SECTION "A"

Presiding: DONALD S. CHILDS, M.D., *Second Vice-president*

SAMUEL BROWN, M.D., Cincinnati, Ohio
"Mechanical Explanation of the Biological Action of Radiation."

H. E. ROBERTSON, M.D., Rochester, Minn.
"Pathologic Anatomy and Radiology: Their Relations and Significance."

EDITH H. QUIMBY, M.A., New York City
"The Intensity of Radiation in the Vicinity of Filtered Radon Implants."

GEORGE E. BINKLEY, M.D., New York City
"Treatment of Rectal Cancer."

Symposium—Technical Methods of Radium Application

Leader, DOUGLAS QUICK, M.D., New York City

CURTIS F. BURNAM, M.D., Baltimore, Md.
"External Distance Applications of Heavily Filtered Radium."

JAMES J. DUFFY, M.D., New York City
"The Use of Gold Tubes of Radium Emanation."

GEORGE W. GRIER, M.D., Pittsburgh, Pa.
"Surface Applications of Radium."

SANFORD WITHERS, M.D., and
JOHN R. RANSON, M.D., Denver, Colorado
"The Use of Radium Element Needles."

WEDNESDAY, NOVEMBER 30
Morning Session, 9 A. M.

SECTION "B"

WALTER BRONSON, M.D., Chicago, Illinois
"Functional Distortions of the Gastric Contour."

A. W. CRANE, M.D., Kalamazoo, Michigan
"Extra-abdominal Affections Giving Gastro-intestinal Symptoms."

BENJAMIN H. ORNDOFF, M.D., Chicago, Illinois
"A Study of Reverse Movements in the Contents of the Duodenum."

E. L. JENKINSON, M.D., Chicago, Illinois
"Gastro-intestinal Disease, with Special Reference to Duodenal Ulcers, Diverticula of the Duodenum and Small Bowel."

PROF. FRANZ M. GROEDEL, M.D., Bad-Nauheim, Germany
"Diverticulitis Coli." (Short demonstration.)

JAMES A. EVANS, M.D., La Crosse, Wis.
"Duodenal Stasis."

Symposium—Do Gastric Ulcers Frequently Become Malignant?

Leader, LEWIS GREGORY COLE, M.D., New York City

CHARLES W. DUVAL, M.D., New Orleans, Louisiana
"Pathological Aspect."

SIDNEY K. SIMON, M.D., New Orleans, La.
"Viewpoint of Gastro-enterology."

LEWIS GREGORY COLE, M.D., New York City
"Roentgenological Aspect."

WEDNESDAY, NOVEMBER 30
Afternoon Session, 1:30 P. M.

DEAN C. C. BASS, M.D., New Orleans, La.
"The Place of Radiology in the Undergraduate Medical Curriculum."

Symposium on Fractures—Radiological and Surgical Aspects

Leader, H. WINNETT ORR, M.D., Lincoln, Nebraska

W. L. ESTES, M.D., Bethlehem, Pa.
"Fractures of the Femur—Methods of Treatment and End-results."

WILLIS CAMPBELL, M.D., Memphis, Tenn.
"Fractures of the Shaft of the Femur. Motion Picture Illustrations (Animated Cartoons) of Special Technical Methods."

MELVIN S. HENDERSON, M.D., Rochester, Minnesota
"The Open Treatment of Fractures—The Importance of Exact Methods in Diagnosis and Reduction."

H. WINNETT ORR, M.D., Lincoln, Nebraska
"End-results in Compound Fractures—The Relationship of Exact Reposition of Fragments to Recovery without Disability."

Evening Session, 8 P. M.

H. BEHNKEN, M.D., Berlin, Germany
"Standardization of Roentgen Dosage."

ANTON LACASSAGNE, M.D., Paris, France
"Action, Direct and Indirect, of Radiation upon Cancerous Tissue."

HERMAN HOLTHUSEN, M.D., Hamburg, Germany
"Biological Aspects of Therapy Radiation."

GEORGE L. CLARK, PH.D., Urbana, Illinois
"X-ray Diagnosis of Chemical and Industrial Materials."

THURSDAY, DECEMBER 1
Morning Session, 9 A. M.

SECTION "A"

Presiding: WILLIAM E. CHAMBERLAIN, M.D., *Third Vice-president*

J. FORESTIER, JR., M.D., Aix-les-Bains, France
"Aix-les-Bains, a French Spa in the Past and Present" (slides and a film).

PROF. FRANZ M. GROEDEL, M.D. (30 minutes), Bad-Nauheim, Germany
"The Differential Diagnosis of the Syphilitic Diseases of the Visceral Organs."

J. M. MARTIN, M.D., Dallas, Texas
Motion Picture Films—"The Cancer Problem."

CLYDE O. DONALDSON, M.D., Kansas City
"Treatment of Cancer of the Cervix."

D. T. QUIGLEY, M.D., Omaha, Nebraska
"Some Neglected Points in the Pathology of Breast Cancer; and Treatment of Breast Cancer."

U. V. PORTMANN, M.D., Cleveland, Ohio
"Radiation Therapy in Carcinoma of the Breast: Supplementary Report."

MARION M. ROLAND, M.D., Oklahoma City, Oklahoma
"Breast Cancer. Case Summary."

J. THOMPSON STEVENS, M.D., Montclair, New Jersey
"Present-day Methods in the Treatment of Carcinoma of the Breast."

THURSDAY, DECEMBER 1
Morning Session, 9 A. M.

SECTION "B"

NELIUS J. NESSA, M.D., Sioux Falls, S. D.
"Roentgenological Diagnosis of Anencephalus."

ALBERT SOILAND, M.D.,
WILLIAM E. COSTOLOW, M.D., and
ORVILLE N. MELAND, M.D., Los Angeles
"The Rôle of Radiation Therapy in Pelvic Conditions Associated with Infections."

HENRY SCHMITZ, M.D., Chicago, Illinois
"Cancer of the Cervix."

Symposium on Lipiodol

Leader, B. H. NICHOLS, M.D., Cleveland, O.

ROBERT H. FRASER, M.D., Battle Creek, Michigan
"Diagnostic Uses of Lipiodol in the Paranasal Sinuses."

J. FORESTIER, JR., M.D. (30 minutes), Aix-les-Bains, France
"The Use of Lipiodol in Neurology."

ROBERT A. ARENS, M.D., and
IRVING F. STEIN, M.D., Chicago, Illinois
"Roentgen Diagnosis in Gynecology—Iodized Oil and Pneumoperitoneum Combined."

D. B. MARTINEZ, M.D., Pittsburgh, Pa.
"Iodionized Oil in the Diagnosis of Pregnancy."

I. C. RUBIN, M.D., New York City
"Localization of Tubal Obstruction by Peri-uterine Tubal Insufflation and Iodized Oil Injections: A Comparative Study of Sixty Cases."

B. H. NICHOLS, M.D., Cleveland, Ohio
"Lipiodol in Relation to Chest Diagnosis."

THURSDAY, DECEMBER 1
Afternoon Session, 1:30 P. M.

SECTION "A"

Leader, LEON J. MENVILLE, M.D., *Chairman, Committee on Scientific Sessions*

GENTZ PERRY, M.D., Rhinelander, Wis.
"The Radiologist and His Ethics."

HENRY W. GROTE, M.D., Bloomington, Ill.
"Status Lymphaticus—Special Reference to the Thymus."

F. MAURICE MCPHEDRAN, M.D., and C. N. WEYL, B.S., Philadelphia, Pennsylvania
"The Value of Synchronization in Accurate Diagnosis of Chest Diseases."

PRESTON M. HICKEY, M.D., Ann Arbor, Michigan
"The Anatomy of the Larynx from the Radiologic Standpoint."

ALTON OCHSNER, M.D., New Orleans, La.
"Bronchography According to the Passive Technic: The Method of Choice for the Roentgenologist."

HOWARD P. DOUB, M.D., Detroit, Michigan
"Fuso-spirochetal Pulmonary Gangrene."

L. R. SANTE, M.D., St. Louis, Missouri
"Pneumothorax."

THURSDAY, DECEMBER 1
Afternoon Session, 1:30 P. M.

SECTION "B"

Symposium on Cholecystography

Leader, JAMES T. CASE, M.D., Battle Creek, Michigan

DANIEL N. SILVERMAN, M.D., New Orleans, Louisiana
"Results of Recent Experimental Research on Gall-bladder Function."

B. R. KIRKLIN, M.D., Rochester, Minn.
"Normal Cholecystographic Response."

CHARLES McCOY, M.D., Cleveland, Ohio
"Development of Roentgenological Examination of the Biliary Tract."
E. H. SKINNER, M.D., and
I. H. LOCKWOOD, M.D., Kansas City, Mo.
"Cholecystography: An Analysis of 1500 Cholecystographic Examinations, with Correlated Clinical and Laboratory Findings, with Special Reference to Pernicious Anemia, Myocardial Degeneration, Infectious Arthritis, and Gastric Acid Content."
LESTER LEVYN, M.D., A. H. AARON, M.D., and EDGAR C. BECK, M.D., Buffalo, New York
"Cholecystography in the Late Months of Pregnancy."
JOSEPH ASPRAY, M.D., Spokane, Wash.
"Results of the Oral Method of Cholecystography."
CARL S. OAKMAN, M.D., Muncie, Indiana
"Correlation of Cholecystography and the Barium Meal."
N. B. NEWCOMER, M.D.,
ELIZABETH NEWCOMER, M.D., and
C. A. CONYERS, M.D., Denver, Colorado
"Conclusions Based upon the Routine Intravenous Administration of Sodium Tetraiodophenolphthalein in Gall-bladder Diagnosis."
W. WARNER WATKINS, M.D., and
HARLAN P. MILLS, M.D., Phoenix, Arizona
"Routine Cholecystography, Based upon Five Hundred Examinations."
JAMES T. CASE, M.D., Battle Creek, Mich.
"Evaluation of Cholecystography in the Light of Operative Findings—Three Hundred Cases Operated Upon."

THURSDAY EVENING, DECEMBER 1

At half-past seven o'clock

THE ANNUAL BANQUET

It is hoped that all members, visitors, and exhibitors will attend.

FRIDAY, DECEMBER 2

Morning Session, 9 A. M.

SCIENTIFIC SESSION

R. P. POTTER, M.D., and
W. G. SEXTON, M.D., Marshfield, Wis.
"Anomalies of the Ureters and the Kidney Pelves."
LESTER A. SMITH, M.D., and
H. O. MERTZ, M.D., Indianapolis, Indiana
"Spina Bifida Occulta and Urological Problems of Childhood."
W. B. BOWMAN, M.D., and
L. S. GOIN, M.D., Los Angeles, California
"Roentgen Findings in Some Obscure Kidney Lesions."
EDWARD S. BLAINE, M.D., Chicago, Illinois
"An Unusual Foreign Body in the Kidney."
W. F. BRAASCH, M.D., Rochester, Minn.
"The Roentgenological Diagnosis of Ureteral Stricture."
W. H. GUY, M.D., Pittsburgh, Pennsylvania
"X-ray Therapy in Non-malignant Dermatological Conditions."
C. AUGUSTUS SIMPSON, M.D., Washington, D. C.
"Cartilage Malignancy Associated with Epitheliomas."
ZOE ALLISON JOHNSTON, M.D., Pittsburgh, Pennsylvania
"The Use of Radium in the Treatment of Nevi."
WALTER I. LE FEVRE, M.D., Cleveland, O.
"Polyradiotherapy in Dermatology." (Lantern Slides.)

FRIDAY, DECEMBER 2

Afternoon Session, 1:30 P. M.

SCIENTIFIC SESSION

E. G. C. WILLIAMS, Danville, Illinois
"A Selected Wave Length for Deep Therapy."
J. H. MUSSER, M.D., New Orleans, La.
"Roentgenology from the Point of View of an Internist."
HENRY C. PILLSBURY, M.D. (Major, Medical Corps), Fort Sam Houston, Texas
"The Progress of Roentgenology in the Army."
WHEELER P. DAVEY, PH.D., State College, Pennsylvania
"X-ray as a Tool in Industry and in Physio-chemical Research."
CHARLES W. DUVAL, M.D., New Orleans
"The Consideration of the Pathology of Certain Splenomegalies."
MAURICE L. KAPLAN, M.D., Chicago, Ill.
"X-ray Therapy in Blood Dyscrasias."
LEON T. LEWALD, M.D., New York City
"Anomalies of the Chest and Abdomen of Unusual Interest."
A. MUTSCHELLER, PH.D., New York City
"Safety Protection Standards."

FRIDAY EVENING, DECEMBER 2

"DO AS YOU PLEASE NIGHT"

SATURDAY, DECEMBER 3

7 A. M.

Visit to U. S. Marine Hospital No. 66, Carville, Louisiana (Leper Colony), by invitation of O. E. Denney, M.D., D.T.M., Medical Officer in Charge. Arrangements must be made in advance at the registration desk.

LIST OF CLINICS

These clinics are prepared for the purpose of demonstrating the method of the leader in diagnostic study and interpretation of roentgenographic, roentgenoscopic, and roentgenotherapeutic work.

4 P. M.

Room No. 1. BONE

Monday, EDWARD S. BLAINE, M.D.
Practical Phases, Technic and Interpretation of Bone and Joint Injuries.
Tuesday, CHARLES G. SUTHERLAND, M.D.
Bone Diseases.
Wednesday, AMEDEE GRANGER, M.D.
Sinuses and Mastoids.
Thursday, J. C. BLOODGOOD, M.D.
Bone Tumors.
Friday, Request Clinic.

Room No. 2. GASTRO-INTESTINAL

Monday, LEWIS GREGORY COLE, M.D.
Methods of Serial Roentgenography in the Diagnosis of Gastro-intestinal Lesions.
Tuesday, BENJAMIN H. ORNDOFF, M.D.
The Stomach and Duodenum.
Wednesday, JAMES T. CASE, M.D.
Diagnosis of Diseases of the Colon.
Thursday, LEON T. LEWALD, M.D.
Gastro-intestinal Diseases in Children.
Friday, Request Clinic

Room No. 3. CHEST

Monday, F. MAURICE MCPEDRAN, M.D.
Synchronization in Chest Diagnosis.
Tuesday, L. R. SANTE, M.D.
Acute Non-tuberculous Conditions of the Chest.
Wednesday, J. FORESTIER, JR., M.D.
Lipiodol in Chest Diagnosis.
Thursday, Lipiodol in Lesions of the Nervous System.
Friday, Request Clinic

Room No. 4. MISCELLANEOUS TOPICS

Monday, A. W. ERSKINE, M.D., and E. A. POHLE, M.D.
Problems in Practical Dosimetry.
Tuesday, W. E. CHAMBERLAIN, M.D., R. R. NEWELL, M.D., OTTO GLASSER, PH.D., and U. V. PORTMANN, M.D.
Dosimetry, continued.
Wednesday, PRESTON M. HICKEY, M.D.
Localization of Foreign Bodies in the Eye.
Thursday, B. H. NICHOLS, M.D.
Urinary Tract.
Friday, SHERWOOD MOORE, M.D.
Cholecystography.

Room No. 5 THERAPY

Monday, SANFORD WITHERS, M.D., and JOHN R. RANSON, M.D.
Treatment of Malignancy of the Head and Neck.
Tuesday, A. U. DESJARDINS, M.D.
Lymphoblastoma.
Wednesday, BURTON J. LEE, M.D.
Treatment of Carcinoma of the Breast.
Thursday, HENRY SCHMITZ, M.D.
Treatment of Diseases of the Female Pelvic Organs.
Friday, Request Clinic.

SCIENCE SERVICE

THE INSTITUTION FOR THE POPULARIZATION OF SCIENCE

Science Service is a unique institution, established at Washington for the purpose of disseminating scientific information to the public. It aims to act as a sort of liaison agency between scientific circles and the world at large. It interprets original research and reports the meetings of learned societies in a way to enlighten the layman. The specialist is likewise a layman in every science except his own and he, too, needs to have new things explained to him in non-technical language. Scientific progress is so rapid and revolutionary nowadays that no one can keep up with it from what he learned at school. Science Service endeavors to provide life-continuation courses in all the sciences for newspaper readers anywhere in America without tuition fees or entrance examinations.

In a democracy like ours it is particularly important that the people as a whole should so far as possible understand the aims and achievements of modern science, not only because of the value of such knowledge to themselves but because research directly or

indirectly depends upon popular appreciation of its methods. In fact the success of democratic institutions, as well as the prosperity of the individual, may be said to depend upon the ability of people to distinguish between science and fakes, between the genuine expert and the pretender.

Science Service spares no pains or expense in the endeavor (1) to get the best possible quality of popular science writing and (2) to get it to the largest possible number of readers. If in doing this it can make both ends meet, so much the better. If not, it will do it anyway.

Through the generosity of E. W. Scripps, Science Service has been assured of such financial support as to insure its independence and permanence. Mr. Scripps's long and wide experience as a newspaper editor and proprietor had convinced him of the importance of scientific research as the foundation of the prosperity of the nation and as guide to sound thinking and living and he realized the need for an independent agency that would bring the results of research to the attention of the entire people so these could be applied to the solution of their personal, social or political problems.

Science Service is chartered as a nonprofitmaking institution and all receipts from articles, books, lectures and films are devoted to opening up new avenues for the diffusion of knowledge and developing promising methods of popular education. Although Science Service has a philanthropic purpose, it is conducted on business principles, with the aim of making each branch of its activities ultimately self-supporting so far as possible. All acceptable contributions are paid for and all published articles are charged for.

Science Service is under the control of a Board of Trustees composed of ten scientists and five journalists. The leading national organizations of all the sciences, the National Academy of Sciences, the National Research Council, and the American Association for the Advancement of Science, appoint three trustees each.

Science Service occupies offices in the magnificent new building of the National Academy of Sciences and the National Research Council on Potomac Park opposite the Lincoln Memorial. This strategic situation enables the Service to keep constantly in touch with the progress of the sciences because new inventions and discoveries are promptly put on exhibition in the building, and the Council brings together investigators in the various sciences and leaders in engineering and industry from all parts of the country.

Science Service is not a governmental institution, but it is in close contact with the numerous governmental bureaus of research. It is not under the control of any clique, class or commercial interest. It has no connection with any particular publisher or syndicate. It will supply any news agency or newspaper on even terms. It is not the organ of any single scientific association. It serves all the sciences. It engages in no propaganda, unless it be called propaganda to urge the value of research and the usefulness of science.

Science Service began its work on January 1, 1921, and has now an office staff of fifteen with a large corps of contributors in the chief research institutions of this country and Europe. Its chief activities at present are:

Science News Bulletin.—A daily syndicated series of brief non-technical articles on new discoveries, inventions and events in the various fields of science, with special reference to their application to industry, commerce and daily life. This is sold to one newspaper in each city.

Telegraphic Service.—Spot news such as new inventions and discoveries, earthquakes, comets, explorations, etc., and the meetings of the American Association for the Ad-

vancement of Science, the National Academy of Sciences, the American Chemical Society and other scientific societies are covered by dispatches telegraphed daily to newspapers.

Feature Articles.—A weekly service of newspaper feature articles illustrated with photographs and drawings.

Why the Weather.—A daily series of brief authoritative explanations of meteorological phenomena, syndicated to newspapers.

Test Yourself.—A series of psychological tests of alertness, intelligence and character, syndicated to newspapers.

Nature's Notebook.—A daily story of the happenings in field and forest, river and sea for use by newspapers when such news is seasonable. Illustrated with drawings in matrix form.

Star Map.—A monthly chart of the heavens which enables the layman to understand and enjoy the beauties of the night sky. Descriptive text accompanies map which is furnished in matrix form.

Science Shorts.—An assortment of interesting and authoritative short items on science, old and new, to be used as fillers by newspapers. Issued weekly.

Special Newspaper Features.—Important events of a scientific nature, such as eclipses, expeditions and explorations, etc., are covered for newspapers in special articles distributed by mail and telegraph.

Other Syndicate Features.—Other newspaper features are offered from time to time, either produced by the Science Service staff or in co-operation with outside authors.

Science News-letter.—A weekly edition of the Daily Science News Bulletin with the addition of book reviews and other features, mailed without publication privilege at cost ($5 a year) for the benefit of teachers, librarians and individuals who want such a means of keeping up with science.

Photographs of Scientists.—Science Service carries in stock for immediate mailing to individuals and newspapers the collection of 1,200 photographs of men and women working in science.

Magazine Articles.—Science Service is prepared to supply periodicals of any kind with readable and accurate articles on scientific subjects, written either by its staff or the investigators themselves in any specified style and length and illustrated if desired.

Books.—Science Service is engaged in writing, editing, revision and criticism of manuscripts for many publishers. Among the books so far published which members of the staff have taken part in promoting are: "Keeping up with Science," "Chats on Science," and "Sermons of a Chemist," by Edwin E. Slosson; "The Story of Copper," by Watson Davis; "Science Remaking the World," by Otis W. Caldwell and Edwin E. Slosson; "Why the Weather," by Charles F. Brooks; "Everyday Mysteries," by C. G. Abbot; "Dwellers of Sea and Land," by William Crowder.

Lectures and Radio.—Science Service offers and manages lectures in various fields of science. The Director gives about forty lectures a year to clubs, universities, forums and societies from the Atlantic to the Pacific. A radio talk on science is broadcast weekly through WCAP in co-operation with the National Research Council.

In order to carry out its plan for awakening a wider interest in scientific questions and a better appreciation of the aims and results of scientific research, Science Service desires to enlist the co-operation of investigators in all fields. If they will send in advance information when their researches are approaching the point of publicity, press accounts can be prepared in time to be returned to them for revision, and then held until the specified date of release. In this way an accurate and authoritative statement will reach the public instead of a hastily written and sometimes erroneous report,

such as may otherwise appear in the newspapers. Complete copies or proof sheets, not merely abstracts, should be sent to Science Service two or more weeks before the paper is to be read or published.

Science Service wishes to secure correspondents in every university and center of research who have the time, disposition and ability to collect news and write for newspapers and non-technical periodicals. The Director particularly wants to get in touch with young men and women in the various sciences who have literary inclinations and would be willing to submit to rigorous criticism and training with a view to making the writing of popular science a part of their life work.

The Managing Editor wants to learn from newspapers and periodicals what sort of scientific news they need. If editors will notify Science Service by mail or telegraph whenever they want an article on any scientific subject, an effort will be made to find the best authority to write it.

Those interested in the promotion and popularization of science may wish to make known to their local newspapers and to other publications the opportunity of obtaining authentic and interesting material from Science Service.

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In the building of the National Academy of Sciences and National Research Council, 21st and B Sts. N. W., Washington, D. C.

THE NEW RADIOLOGICAL DEPARTMENT, ROYAL INFIRMARY, EDINBURGH

This splendidly equipped institution, of which Dr. J. M. Woodburn Morison is Medical Officer in charge, was opened in October, 1926, and since then has been visited by physicians and physicists from many parts of the world. To those who have not had the opportunity of personally inspecting this modern installation a brief sketch may be of interest. Likewise, the interval since its opening has demonstrated that it is practically workable as well as theoretically well-nigh perfect.

The perfection of the installation is no

doubt due to the fact that the department has been specially designed and built, and it has been possible to arrange the building in such a manner as to include all the most modern ideas regarding X-ray installations. It is interesting to note how much may be done to overcome natural difficulties when a free hand is allowed by the authorities to those responsible for an installation. The conditions at Edinburgh were anything but favorable. The department had to occupy a site between the Medical and Surgical Houses, peculiar in shape and having a difference in levels. Those members of the medical profession who are familiar with the Royal Infirmary, Edinburgh, will doubtless remember "the duodenum," the curved passage between the medical and surgical departments. The new radiological department runs along one side of this passage.

The structural scheme of protection rests on the use of tongued and grooved barium sulphate slabs for the construction of walls, ceilings, and floors of all rooms devoted to X-ray work. The walls and ceilings are further surfaced with barium sulphate plaster. On the basis of laboratory measurements of test samples, the equivalent of 5 mm. of lead would appear to have been secured. The doors, of the hinged type, are protected with two thicknesses of 6-pound lead, the joints being suitably overlapped. The observation windows in the doors and operators' cubicles are glazed with two sheets, superimposed, of Super Protex glass, giving a protection likewise of 5 mm. of lead.

The important question of voltage variation has been regulated by the builders by means of a Tirrill automatic voltage regulator. The principle upon which this operates, the equipment for deep therapy and for electrical and ultra-violet treatment, the system of ventilation are all explained lucidly in a brochure issued by the builders, and which they will be glad to send to such members of the Society as will address a request to them. The address is Watson and Sons, Ltd., Sunic House, 43, Parker Street, Kingsway, London, W. C. 2.

SECOND INTERNATIONAL CONGRESS OF RADIOLOGY

Any one who contemplates attending the Second International Congress of Radiology, to be held in Stockholm, July 23-27, 1928, should secure membership in the Congress by filling out the accompanying enrollment blank (see also RADIOLOGY, September, 1927, p. 255), and forwarding it, with the required fee (40 Swedish crowns: 1 crown—or kronor—is worth about 27 cents), to Dr. Axel Renander, Secretary-General, Sophiahemmet, Stockholm, Sweden.

The Congress Bureau has informed the American Committee that it will undertake to engage rooms for Congress members in hotels, boarding houses, and also, where this

SECOND INTERNATIONAL CONGRESS OF RADIOLOGY, 1928, STOCKHOLM, SWEDEN

I desire to be enrolled as a member of the Congress. The amount of my subscription (40 Swedish crowns) is sent by p. o. o.
check

Name in full: .....

Title: .....

Address in full: .....

1927.

Checks and money orders payable to International Congress of Radiology, Stockholm.

is particularly desired, in private families. The rooms will be available to members at most favorable prices. Rooms in hotels will range between the following rates: one bed, 5 to 12 kronor (about $1.25 to $3.00); two beds, 8 to 23 kronor (about $2.00 to $5.75), with about double these prices if a private bath is wanted. A number of rooms can be had in boarding houses or private families for from about 4 kronor ($1.00) up. Breakfast is not included in any of these prices. This will, as a rule, cost about 1 kronor (25-27 cents, according to the rate of exchange).

Those members who wish to avail themselves of the Congress Bureau in obtaining rooms should make application to the Secretary-General, stating the number of beds, the price, and whether or not private baths are wanted.

Early registration and requests for accommodations will greatly facilitate the work of the Central Committee.

The Central Committee in Stockholm, of which Dr. Gösta Forssell is President and Dr. Axel Renander Secretary-General, has appointed the following American Committee to have charge of arrangements for the participation of the United States and Canada in the proceedings of the Congress: Dr George E. Pfahler, Dr. Preston M. Hickey, Dr. Leopold Jaches, Dr. George W. Holmes, Dr. Edwin C. Ernst, Dr. Albert Soiland, and Dr. A. C. Christie. The Committee met on September 21, 1927, with six of the seven members present and in accordance with authority granted it by the Central Committee enlarged itself by the addition of the following members to represent the societies named: Dr. A. H. Pirie, American Roentgen Ray Society; Dr. M. J. Hubeny, American College of Radiology; Dr. E. W. Rowe, Radiological Society of North America; Dr. C. F. Burnam, American Radium Society; Dr. E. H. Skinner, Section on Radiology, American Medical Association; Dr. Stanley Kirkland, Section on Radiology, Canadian Medical Association; Dr. C. F. Stokes, American Electrotherapeutic Association. The following officers were elected: President, Dr. George E. Pfahler; Vice-president, Dr. A. H. Pirie; Secretary, Dr. A. C. Christie.

The Committee is charged with recommending to the Central Committee all participants from the United States and Canada in the scientific program of the Congress. In order to secure the best possible representation from our countries the Committee is requesting the presidents of all radiological organizations of national scope to send in recommendations of possible participants in the program. When these are received the Committee will carefully select those to be invited to participate, in order to secure a proper division of the papers to represent the various subjects with which the Congress will occupy itself.

The Committee is securing information with regard to transportation and will publish from time to time all information that comes to it regarding sailings, rates, and itineraries. The secretaries of the various national radiological societies have been requested to furnish to the different transportation companies complete lists of their members, and the companies will in turn get in touch with each member either through correspondence or through their local representatives. It has not been thought advisable for the Committee to attempt to arrange tours for groups, but it will be glad to co-operate in obtaining all possible information for any persons who wish to form groups either for the ocean trip or for visits to European clinics. All communications should be addressed to Dr. A. C. Christie, Secretary, American Committee, 1909 Massachusetts Avenue, N. W., Washington, D. C.

At the committee meeting in September Dr. Jaches presented letters, memoranda,

and cablegrams from the Central Committee in Stockholm, announcing the arrangements and rules which have been agreed upon. The Committee is informed that about twenty papers by American authors may be read during the meeting and that it devolves upon the American Committee to choose the papers which shall be presented by Americans.

A cablegram from Dr. Forssell was presented, requesting the American Committee to choose one special lecturer on teaching in radiology and one special lecturer on the scope of roentgen thorax diagnosis. The Committee selected Dr. P. M. Hickey to deliver the lecture on teaching in radiology, and Dr. Leopold Jaches to deliver the lecture on thorax diagnosis.

The Secretary was directed to inquire from the Central Committee how many official delegates are to be appointed from America. After the Committee had adjourned a letter was received from Dr. Forssell stating that each country having a radiological society is entitled to a maximum of five delegates.

The Committee passed a resolution to invite the International Congress to meet in America in 1931.

A motion was passed to invite the following to give papers before the Congress:

Dr. W. F. Manges, on some subject pertaining to foreign bodies in the air passages.

Dr. H. K. Pancoast, a résumé of the American work on brain tumors.

Dr. Lester R. Whitaker, on the physiology of the gall bladder.

Some member of the Mayo Clinic, on diagnosis by cholecystography.

The Secretary was directed to notify the President of the Congress of all action taken by the American Committee; to inquire whether there will be a scientific exhibit in addition to the commercial exhibit planned, and to secure publicity for all items of interest regarding the Congress in appropriate journals. The Secretary was also directed to represent to the Central Committee the desirability of publishing abstracts in English, French, and German of all papers to be read at the Congress. The Committee obligated itself to attempt to raise a fund in America to help defray the expense of such publication. The Committee directed the Secretary to obtain a cable address and to communicate it to the President of the Congress.

SUGGESTED ITINERARIES

Tour I

May 30 Sail from New York by Cunard Line Cabin Steamer *Lancastria.*

June 8 Arrive Havre and rail to Paris.

June 9 to 21 *In Paris.* Private automobile bus and guide will be at the passengers' disposal for two days' sightseeing, as follows: First day—Visiting the city, including the Louvre, Cathedral of Nôtre Dame, Eiffel Tower, Napoleon's Tomb, Tomb of the Unknown Soldier, etc.; second day—To Versailles and the Château of Malmaison.

June 22 Day train *via* Metz to Frankfurt.

June 23 to 27 *In Frankfurt.* Private automobile and guide will be at passengers' disposal for one day's sightseeing about the city.

June 28 Rail to Nuremberg.

June 29 To Vienna.

June 30 to July 4 *In Vienna.* Private automobile bus and guide will be provided for one day's drive around the city, visiting the many points of interest.

July 5 Rail to Prague.

July 6 To Berlin.

July 7 to 11 *In Berlin.* Private automobile bus and guide provided for half-day's drive in the city and one day to Potsdam and return.

July 12 To Hamburg on morning train.

July 13 to 17 *In Hamburg.* Private automobile and guide will be at passengers' disposal for one day's sightseeing around the city.

July 18 Day train to Copenhagen.

July 19, 20 *In Copenhagen.* Private automobile bus and guide provided for one day's

sightseeing about the city. Night train for Stockholm. (Sleeping car berth included.)

July 21 Arrive Stockholm, A. M.

July 22 to 28 *In Stockholm.* Private automobile bus and guide will be at the passengers' disposal for one day's sightseeing about the city, also excursion on one day by automobile to Upsala and return.

July 28 Leave by steamer *via* Gota Canal for Gothenburg.

July 30 *En route* on canal steamer.

July 31 Arrive Gothenburg.

Aug. 1 Embark on Swedish Lloyd steamer for Tilbury.

Aug. 2 At sea.

Aug. 3 Arrive Tilbury and rail to London.

Aug 4 to 10 *In London.* Private automobile bus and guide will be at passengers' disposal for two days' visiting of the following points of interest: First day—Excursion around the city, including London Museum, Tower of London, St. Paul's Cathedral, Guildhall, Mansion House, Buckingham Palace, etc.; second day—To Windsor Castle, Eton College, and Stoke Poges.

Aug. 11 Rail to Southampton and sail by Cunard Line Cabin Steamer.

Tour II

July 5 Sail from New York by Swedish-American Line steamer about this date.

July 14 Arrive Gothenburg.

July 15, 16 *In Gothenburg.* Private automobile and guide will be at the disposal of the passengers for one day's sightseeing about the city.

July 17 Leave by Gota Canal steamer for Stockholm in the evening.

July 18 *En route* on Gota Canal.

July 19 Arrive Stockholm in the evening.

July 20 to 28 *In Stockholm.* Private automobile bus and guide will be at the disposal of the passengers for one day's sightseeing about the city, also excursion on one day by automobile to Upsala and return. Leave on night train for Copenhagen. (Sleeping car berth included.)

July 29, 30 *In Copenhagen.* Private automobile bus and guide provided for one day's sightseeing about the city.

July 31 Day train to Hamburg.

Aug. 1 to 5 *In Hamburg.* Private automobile bus and guide provided for one day's sightseeing around the city.

Aug. 6 Morning train to Berlin.

Aug. 7 to 11 *In Berlin.* Private automobile bus and guide provided for half-day's drive in the city, also one day to Potsdam and return.

Aug. 12 Rail to Prague.

Aug. 13 To Vienna.

Aug. 14 to 18 *In Vienna.* Private automobile bus and guide will be at the passengers' disposal for one day's sightseeing to points of interest about the city.

Aug. 19 Rail to Nuremberg.

Aug. 20 To Frankfurt.

Aug. 21 to 25 *In Frankfurt.* Private automobile and guide will be at passengers' disposal for one day's sightseeing about the city.

Aug. 26 Day express *via* Metz to Paris.

Aug. 27 to Sept. 7 *In Paris.* Private automobile and guide will be at passengers' disposal for two days' sightseeing, as follows: First day—in the city, visiting the Louvre, Cathedral of Nôtre Dame, Eiffel Tower, Napoleon's Tomb, Tomb of the Unknown Soldier, etc.; second day—to Versailles and the Château of Malmaison.

Sept. 8 *Via* Calais and Dover to London.

Sept. 9 to 15 *In London.* Private automobile bus and guide will be at the disposal of the passengers for two days' sightseeing, as follows: First day—in the city, visiting London Museum, Tower of London, St. Paul's Cathedral, Buckingham Palace, etc.; second day—to Windsor Castle, Eton Sollege, Stoke Poges.

Sept. 16 Rail to Southampton and sail for New York by Cunard Line Cabin Steamer.

Tour III

July 5 Sail from New York by Swedish-American Line steamer about this date.

July 14 Arrive Gothenburg.

July 15, 16 *In Gothenburg.* Private automobile and guide will be at the disposal of

the passengers for one day's sightseeing about the city.

July 17 Leave by Gota Canal steamer for Stockholm.

July 18 *En route* on Gota Canal.

July 19 Arrive at Stockholm in the evening.

July 20 to 28 *In Stockholm.* Private automobile bus and guide will be at passengers' disposal for one day's sightseeing about the city, also excursion on one day by automobile to Upsala and return. Night of the twenty-eighth to be spent at Stockholm.

July 29 Rail to Gothenburg.

July 30 Sail for New York about this date by Swedish-American Line steamer.

Tour IV

July 7 Sail from New York on S. S. *Republic* of the United States Line.

July 19 Arrive Bremen.

July 20 Leave on morning train *via* Malmo. (Sleeping car berth included.)

July 21 Arrive Stockholm, A. M.

July 22 to 28 *In Stockholm.* Private automobile and guide will be at passengers' disposal for one day's drive about the city, also excursion on one day to Upsala and return.

July 29 Rail to Gothenburg.

July 30 Sail for New York about this date by Swedish-American Line steamer. (1928 sailings not yet published.)

The rates for the above itineraries will be as follows:

Tour I. $632.00 each of 15 persons if "Ordinary First" hotels, and $794.00 if "Superior First" hotels.

Tour II. $620.00 each of 15 persons if "Ordinary First" hotels, and $784.00 if "Superior First" hotels.

Tour III. $151.00 each of 15 persons if "Ordinary First" hotels, and $177.00 if "Superior First" hotels.

Tour IV. $137.00 each of 15 persons if "Ordinary First" hotels, and $158.00 if "Superior First" hotels.

These rates will provide for the following services:

Rail and steamer transportation tickets in accordance with the itinerary. The class to be second on the Continent, third in Great Britain, and saloon on local steamers with "Ordinary First Class" hotels, and first class throughout with "Superior First Class" hotels.

Note: Rooms with private bath will be provided whilst in Paris at "Superior First" hotels. Accommodations will consist of double rooms, without bath, and all meals.

Transfers of passengers and hand-baggage between hotels and railway stations where necessary.

Sightseeing excursions as specified in the itinerary.

Meals *en route* whilst sightseeing and riding on trains.

You will note that the rates are based on a party of 15 persons, and a new quotation must be obtained for a smaller party.

Thomas Cook & Son have furnished these itineraries.

BOOK REVIEWS

A Descriptive Atlas of Visceral Radiograms. By A. P. Bertwistle, M.B., Ch.B., F.R.C.S.Ed., Late Resident Surgical Officer, General Infirmary, Leeds, and E. W. H. Shenton, M.R.C.S., L.R.C.P., Late Senior Surgical Radiographer, Guy's Hospital, London. C. V. Mosby Co., St. Louis. 1926. Pages 250. Price $13.50.

The present work has been published as a companion volume to "A Descriptive Atlas of Radiographs of the Bones and Joints." The authors with the assistance of several eminent specialists have prepared a very graphic outline of the normal and ab-

normal roentgenographic changes of the various organs. They are to be commended on the collection of such a series of representative radiographs, which have been so excellently reproduced by the publishers.

A large portion of the book is devoted to a consideration of the gastro-intestinal tract and the various conditions are illustrated by a most beautiful series of roentgenograms. These are further amplified by drawings and case histories.

The urinary, biliary, and respiratory tracts are covered in a like manner. In addition, the more important lesions of the nervous system, vascular system, teeth and sinuses are depicted.

As is to be expected in a work of this sort the text has been condensed to a mere outline of the more important diagnostic points. Many readers, no doubt, will feel that this portion is almost too brief.

To those who do not enjoy the privileges of a large roentgenologic clinic this work will be of particular value as a source of reference.

CLINICAL PREVENTIVE DENTISTRY. By HOWARD RILEY RAPER, D.M.D. Ritter Dental Mfg. Co., Rochester, N. Y., 1926.

Dr. Raper's work is one that will advance preventive medicine years ahead of its present status. It has been stated with reason that the next great step in preventive medicine will come from the dental profession. "Clinical Preventive Dentistry" has given the dentist the opportunity to prove the above statement.

One of the most definite and most neglected foci of infection in the human anatomy is the pulpless tooth. The dental profession is divided in its opinion as to what action to take regarding this rapidly increasing problem. The medical profession have all too frequently neglected the pulpless tooth and surrounding tissues infected by it.

Here we have a book theoretically and practically correct. We know a vital tooth is seldom a physical menace, and with the confidence our patients place in us, plus the carrying out of Dr. Raper's technic, we can see our way clear to prevent "toothache." In this book it is very distinctly pointed out that the prevention of "toothache" is the conservation of the pulp of the tooth.

The medical profession can well afford to carefully read Part Three of "Clinical Preventive Dentistry," and the general roentgenologist must thoroughly study the book if he is to give interpretations of dental radiographs.

R. H. N.

ANATOMIE RADIOGRAPHIQUE DU SQUELETTE NORMAL (atlas). By J. BELOT and F. LEPENNETIER. Published by Amédée Legrand, Paris, 1927, pages 391. Price not given.

This new atlas of radiographic anatomy is a delight to the reviewer, as it will undoubtedly be to all radiologists who are fortunate enough to possess it. In conception and execution, both from the technical and publishing standpoints, it is as near the ideal as anyone can justly expect and far superior to all the radiographic atlases which have been published heretofore. The excellent and unretouched roentgenograms were made from living subjects and are reproduced in the natural size, but the greatest advantage of this atlas is that, besides the roentgenograms themselves, it contains photographs, from the skeleton, of the same bones and bony regions, in the same position and of the same dimensions as the roentgenograms. In addition, a carefully made diagram faces each roentgenogram

and contains full information concerning the corresponding points on or in the bone, which are shown by the roentgenogram. Belot and Lepennetier deserve the gratitude of all roentgenologists for undertaking and carrying out this work in such thorough fashion.

The atlas proper is preceded by a brief discussion and statement of radiographic geometry; the influence of quantity, quality and scattering of radiation on radiography; a brief discussion of generators and tubes and of accessory apparatus. There are also brief chapters on technic and an excellent presentation of photographic emulsions and processes.

This is a reference work of the first order and deserves a place of honor in the library of every radiologist.

A. U. DESJARDINS, M.D.

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Effect of roentgen rays on metabolism.—The changes in the metabolism of nitrogen and sodium chloride following radiotherapy have been studied before in patients, but no systematic investigations were carried out. This paper relates the results of a research done on 56 guinea pigs of equal age and weight, 36 of which were exposed to 50 per cent E.D., and the rest to 10 per cent E.D. The technical factors were 200 K.V., 0.5 Zn. plus 3.0 Al., 40 cm. F.S.D. Only three animals treated with 50 per cent E.D. survived longer than fourteen days. They were kept in special cages and observed for two months, being fed on a diet consisting of barley and carrots. Neither the weight nor the appetite showed an appreciable loss. The NaCl excretion in the urine was definitely increased; the N content of the blood was decreased in animals which had been treated two months previously with 50 per cent E.D., in those which were exposed to 10 per cent three weeks previously, in untreated animals, and in guinea pigs which had been exposed to 50 per cent E.D. two weeks previously. The N content in organs was decreased in animals treated two weeks previously with 50 per cent E.D., those irradiated two months previously with 50 per cent E.D., in guinea pigs exposed to 10 per cent E.D. three weeks previously, and in untreated controls.

It is concluded from these findings that thev

prove the theory of Nemenow that the metabolism of an injured cell is impaired.

E. A. POHLE, M.D.

Regarding the Effect of Roentgen Rays on the Nitrogen and Sodium Chloride Metabolism: Experimental Investigations. A. Jugenburg. Strahlentherapie, 1927, XXV, 288.

Bladder diverticula.—The mucosa of the urinary bladder is protected from herniation through the bladder wall when the intracystic pressure is suddenly raised, by the arrangement of the three interlacing muscle layers. The outer longitudinal layer has large, loosely woven bundles, as has the inner longitudinal layer; the middle circular layer has small bundles and is much more closely woven.

In sectioning bladder walls it is found that frequently there are left loose fibrous tissue pathways extending entirely through the bladder wall when the intracystic pressure is suddenly raised. Such pathways the essayist considers to be the necessary congenital etiologic factor in the formation of diverticula.

Cystograms, made with varying degrees of intracystic pressure, show a more or less pronounced condition of the diverticulum. The radiogram taken at the point of maximum intracystic pressure will show maximum herniation. To explain the formation of diverticula in children it is necessary to consider only that the larger the congenital defect in the bladder wall the less intracystic pressure is required, and the shorter the duration necessary for this normal intracystic pressure to continue in order that a diverticulum may be formed.

SUMMARY

1. Bladder diverticula are congenital to the extent that a loose fibrous tissue pathway must be present through the bladder wall before the acquired factor, namely, a raised intracystic pressure, can herinate the mucosa.

2. The occurrence of diverticula as to age and sex is determined by the size of the unprotected areas through the bladder wall, the intracystic pressure, and the variations in the fixation of the trigonal area in male and female. In females and children the normal intracystic pressure will herniate the mucosa only through a bladder-wall defect of unusually wide diameter.

3. Diverticula, so diagnosed by cystogram and cystoscopic examination, in apparently normal youths' bladders, have been produced by simply increasing the intracystic pressure sufficiently to force the mucosa through an unsuspected loose fibrous tissue area in the wall.

4. Cystograms of diverticula should be made with known quantities of fluid and known intracystic pressure so that the elasticity of the sac can be determined, as potential diverticula (ballooning cellules) indicate only a removal of the bladder obstruction.

5. This theory of herniation can account for all types of bladder diverticula except ureteral buds and urachal remnants.

L. R. SANTE, M.D.

The Pathogenesis of Bladder Diverticula. D. K. Rose. Archiv. Surg., February, 1927, p. 554.

Familial malformations.—This is a report of two cases, with photographs, of acrocephaly associated with syndactylism occurring in members of the same family. These cases support the view of Park and Powers that the malformations are evidences of defects of the germ plasma rather than the result of externally operating causes.

C. G. SUTHERLAND, M.B. (TOR.)

Combined Acrocephaly and Syndactylism Occurring in Mother and Daughter: A Case Report. A. A. Weech. Bull. Johns Hopkins Hosp., February, 1927, p. 73.

Renal tuberculosis and hydronephrosis.—Coincident hydronephrosis and tuberculosis are unusual, but they do occur and in varied fashion; therefore it is important to know their relationship and possibilities for treatment. Ordinary diagnostic measures can readily recognize such types of cases. If the

case is not a bilateral hydronephrosis with a bilateral tuberculosis, nephrectomy can be safely resorted to in most cases, even if the remaining kidney is hydronephrotic, providing the infection is controlled first and treated or cured after operation.

The proper treatment for tuberculosis in conjunction with hydronephrosis is surgical wherever possible.

ROBERT A. ARENS, M.D.

The Coincidence of Renal Tuberculosis with Hydronephrosis. R. E. Cumming. Jour. Urol., March, 1927, p. 261.

Radiochemical therapy of malignancies.—Werner treated a number of patients suffering from inoperable carcinoma of the breast, tongue, thyroid, rectum, bladder, prostate, uterus, ovary, malignant lymphoma and bone sarcoma, with a combination of roentgen rays or radium and injections of enzytol (10 per cent cholin in boric acid). In some cases remarkable results were observed. Further study of this method seems advisable.

E. A. POHLE, M.D.

Further Communication Regarding the Results of Radiochemical Treatment of Inoperable Neoplasm in Man. R. Werner. Strahlentherapie, 1927, XXV, 76.

Movable kidney, with kink or stricture.—There is a group of conditions of and about the kidney and ureter the diagnosis and treatment of which at present are very much mismanaged. Renal movability with kink and ureteral stricture are two of these conditions most commonly reported, but a great difference of opinion exists in the interpretation of the findings indicating each, as well as in the best method of examination to obtain these findings. It is particularly necessary in the dual differentiation of these obscure conditions that a complete routine study be made. The findings on the ureteropyelogram are subject to marked differences of interpretation as well as method of use. The film may be taken in the Trendelenburg, prone or upright position, with the end of the catheter in the kidney pelvis or at some portion of the ureter. A safe routine is to take a pyelogram in the prone position, with the tip of the catheter in the pelvis, and then, with the tip of the catheter in the lower part of the ureter, take a ureteropyelogram in the upright position. These two films should show changes in the ureteral and pelvic positions and outlines.

F. B. SHELDON, M.D.

Movable Kidney, with Kink or Angulation Versus Ureteral Stricture. Frank Hinman, Morrell Vecki, and Clark M. Johnson. Calif. and Western Med., January, 1927, p. 59.

Cancer of the cervix.—The author divides the epidermoid cancers into several types: (1) spinal-cell carcinoma; (2) transitional carcinoma; (3) spindle-cell carcinoma. Another type is adenocarcinoma, which, however, is a relatively small group. The present study is based on 145 cases of unmistakable carcinoma of the cervix from the gynecological service of the Johns Hopkins Hospital. A panhysterectomy was done in each case. These have all been traced for five years or more. In cases selected as operable according to that hospital's criterion, patients are reported alive at the end of five years after operation in the following percentages: Spinal-cell carcinoma, 63.6 per cent; transitional-cell carcinoma, 46 per cent; spindle-cell carcinoma, 14 per cent; adenocarcinoma, 75 per cent. The latter group of cases, however, was very small. This does not take into account the immediate mortality from operation.

Certain deductions are made from the clinical experience in these cases.

1. Extensions or metastases, when demonstrable in either the regional lymph nodes, adnexa, bladder, rectum, or pericervical tissues render impossible an ultimate operative cure.
2. Extension to the vagina warrants a more unfavorable prognosis than uterine extension.
3. In the case of spinal- and transitional-cell carcinoma a duration of symptoms exceeding eight months is sufficient to put the patient beyond the scope of operative cure. In the

case of a spindle-cell carcinoma this study would indicate that this time is probably too liberal.

4. The degree of cervical involvement, providing no pericervical involvement has occurred, appears to be a relatively unimportant factor in the spinal-cell and adenocarcinoma. In the case of the transitional-cell carcinoma, however, extensive involvement is greatly against operative cure.

5. Curettage for diagnosis several days prior to operation for radical extirpation does not render the prognosis hopeless.

HOWARD P. DOUB, M.D.

Carcinoma of the Cervix Uteri: Its Operative Prognosis: A Clinical and Pathological Study to Ascertain the Prognosis Following Operation for Extirpation of the Malignant Process. Karl H. Martzloff. Bull. Johns Hopkins Hosp., March, 1927, p. 160.

Roentgen ray in neurology.—In a study of 63 cases, with neurological symptoms such as headache, petit mal, or convulsions, encephalography was employed. These studies were made by injection of air, either through a lumbar puncture or a small trephine or by the combined use of both methods in connection with roentgen-ray films. From the information gained by encephalography in connection with the history and clinical data, a satisfactory working diagnosis was obtained in practically all cases. This method of diagnosis is indispensable in patients with headache, petit mal, convulsions, impaired mentality, and other vague neurologic complaints more or less chronic and recurring, and especially so in patients with brain tumor, hydrocephalus, or abscess. Encephalography by the lumbar puncture method under ether anesthesia in the sitting position is devoid of serious reactions. Either distention of the membranes or the reaction of the presence of air in this form of encephalography is beneficial in certain types of headaches, but the treatment requires a thorough working knowledge of neurology as well as neurosurgical training and roentgen-ray interpretation.

ROBERT A. ARENS, M.D.

Encephalography: Lumbar Puncture and Trephine Methods. E. R. Carpenter. Am. Jour. Med. Sci., March, 1927, p. 333.

Pneumothorax.—By making roentgenologic examinations of the patient in various positions the author judges to what extent the mediastinum is movable and also exactly where the lung is held up by adhesions and where the visceral pleura is in contact with the chest wall but not actually adherent. If plates taken with the patient on the side are not sufficiently clear to show the diaphragm or base of the lung, and if the patient is active and sufficiently well, radiographs are taken with the patient standing on his head. The fluid gravitates to the apex and a clear view of the base is thus obtained.

SOLOMON FINEMAN, M.D.

The Effect of Posture on Cases of Pneumothorax. L. S. T. Burrell. Brit. Med. Jour., Jan. 22, 1927, p. 135.

Why does radiotherapy fail to cure cancer?—Wintz gives in this paper a number of reasons for failures in radiotherapy; they may be of a biological or physico-dosimetrical nature. There is no doubt that the biological part of the cancer problem is little understood. On the other hand, it is so closely connected with the problem of dosage that a complete separation of the two is impossible. He emphasizes that the so-called cancer dose should not be interpreted as cure dose but as the minimum amount of radiation energy required to destroy all cancer cells. Radiation during the stage of mitosis offers rather better results because at that time the tumor susceptibility appears to be 20 to 40 per cent higher. One often violated rule is the protection of the surrounding tissue. It must also be borne in mind that the interval between divided doses

should not exceed a certain time, because five times 20 per cent S. U. D., given every second day, corresponds to 60 per cent given at one sitting. A number of small doses seems to decrease the susceptibility of the carcinoma and to increase that of the normal tissue. The effect of scattered radiation has been underestimated in many experiments and clinical observations. All the biological questions are solvable only if we have an absolute dosage system. Our whole aim must, therefore, be directed to this end.

E. A. POHLE, M.D.

Reasons for Failures in Radiation Therapy of Carcinoma. Hermann Wintz. Strahlentherapie, 1927, XXV, 1.

The duodenum and pyloric regurgitation.—Antiperistalsis is a normal movement of the duodenum. Its effects are to delay the food in the duodenum, to insure its admixture with the digestive juices, and to produce conditions favorable to regurgitation into the stomach. The duodenal cap is filled periodically from the duodenum, the pyloric sphincter preventing regurgitation into the stomach. In addition to its function of regulating the output from the stomach the pyloric sphincter prevents regurgitation from the duodenum in the early stages of digestion; as digestion proceeds, it commences to relax independently of gastric peristalsis, promotes regurgitation, and thus regulates the acidity of the gastric contents. An actual swing back of food from the second part of the duodenum is not always necessary to produce regurgitation, since a full cap with a momentary relaxation of the pylorus will produce it, as we have observed.

M. J. GEYMAN, M.D.

Antiperistalsis of the Duodenum and its Relation to Pyloric Regurgitation. Charles Bolton and R. W. A. Salmond. Lancet, June 11, 1927, p. 1230.

Dose and effect.—In order to study the relation between doses of roentgen rays and their biological effect, the author exposed cultures of *B. typhi muris* to the secondary radiation of copper for from 50 to 140 minutes. The Petri dishes were placed in the incubator for twenty-four hours and then the number of colonies counted. When plotting graphically, it appeared that the effect of roentgen rays on the bacilli followed the exponential law. The same relation could be demonstrated if the ovaries of women were treated with 25 to 30 per cent, 35 to 40 per cent, and 80 per cent S.U.D., and the number of cases still menstruating after four weeks counted. A practical conclusion from the author's curves is the fact that an increase of the amount of radiation within the range of small doses is accompanied by an augmented biological effect; the same does not hold true in the higher dose range.

E. A. POHLE, M.D.

Regarding the Dependence of the Biological Effect from the Roentgen-ray Dose. Heinrich Guthmann. Strahlentherapie, 1927, XXV, 280.

REGISTERED X-RAY TECHNICIAN, male, married, with seven years' experience (also do physical therapy), wishes to work with congenial employer who has good equipment. I can produce. Write me. Address A-33, care RADIOLOGY.

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